Prevalence of active HCV infection and associated risk factors among members of Forcibly Displaced Myanmar National (FDMN) Population residing in camps, Cox's Bazar, Bangladesh

Protocol: Version 1.1, 30/01/2023
MSF ERB No: 2287
BUHS ERC number: BUHS/ERC/EA/22/46

Final report – November 2023

Birgit Schramm, Khondaker Ahsanul Ashakin

epicentre
ÉPIDÉMIOLOGIE • EPIDEMIOLOGY

MEDECINS SANS FRONTIERES

EXECUTIVE SUMMARY

Introduction

Hepatitis C virus (HCV) infection is a significant public health concern, causing approximately 400,000 deaths annually, primarily due to cirrhosis or hepatocellular carcinoma. While approximately 30% of individuals clear the infection spontaneously, the remaining 70% face the risk of life-threatening outcomes if untreated [1]. Globally, an estimated 58 million people were chronically infected in 2019, with a disproportionate burden in low- and middle-income countries (LMICs). In 2019, approximately 290 000 people died from hepatitis C, mostly from cirrhosis and hepatocellular carcinoma [2].

Limited available data suggested an alarming and unusually high seroprevalence of Hepatitis C (presence of HCV antibodies following HCV exposure) among Rohingya or Forcibly Displaced Myanmar National (FDMN) people residing in densely crowded camps that host nearly one million people located in Cox's Bazar district, Bangladesh [3][4][5]. Médecins Sans Frontieres (MSF) is currently the only actor providing limited (quota-based) access to HCV treatment in the camps. Representative data on the prevalence of active HCV infection and risk factors of exposure were urgently needed to inform HCV response in the camps.

Methods

A cross-sectional point-prevalence survey targeted 680 randomly selected households in seven camps in Cox's Bazar, covering the catchment area of Médecins Sans Frontières (MSF) Operational Center Paris (OCP). Adults (≥18 y) were randomly selected (one per household) and screened for HCV seropositivity using an antibody rapid diagnostic test (RDT). Active HCV infection was confirmed using Xpert® HCV Viral Load testing, and a structured questionnaire was administered to collect sociodemographic data and identify risk factors.

Results

Between May and June 2023, 641 individuals from 641 households were included, 66.3% female, and a median age of 34 years [IQR 28, 46]. The survey-adjusted estimate of **HCV seroprevalence was high at 29.7% (95%CI: 26.0-22.8).** Among 637 participants who had completed HCV testing, the **survey-adjusted active infection prevalence was 19.6% (16.4-23.2)**, with all viremic individuals having a viral load ≥ 1000 IU/ml. The survey-adjusted viremic ratio among HCV seropositives was 66.6 % (58.9-73.6)). About one-third (36.7%) of HCV seropositive participants reported previous HCV diagnosis, and 10.5% reported previous HCV treatment. About half (48.5%) had heard about Hepatitis C, 34.2% indicated that HCV infection can be prevented, 41.8% responded that HCV treatment is available.

Multivariate regression analysis revealed higher odds of HCV seropositivity for women (adjusted odds ratio (aOR)=1.8) and older age groups (aORs ranging from 2.3 to 2.9). Furthermore, associations were identified between HCV seropositivity and reported surgery (aOR=4.7 (95%CI: 1.3-16.7) or medical injections (aOR=1.7 (95% CI: 1.0-2.6).

Many (70.4%) had reported medical injection(s), while surgery was infrequently reported (3.3%). Few also reported re-use of someone else's needle or blood transfusion, which were found associated with

HCV seropositivity but did not remain significant in sensitivity analysis omitting participants with missing values, refused answers or replies of “don’t know). Camp-specific seroprevalence estimates varied, with a significantly lower seroprevalence specifically in camp 17 (confirmed in multivariate regression analysis). The odds of active HCV infection among HCV seropositive were about 10 times higher among those who did not report previous HCV treatment (aOR= 9.4 (95%CI: 2.2 -40.5)).

The current survey has, for the first time, offered a representative estimate of active HCV infection within the FDMN population in the Cox’s Bazar camps. Limitations stem from a potential bias towards surveying individuals at home during the survey period, evident in a somewhat higher proportion of women included compared to UNHCR camp population statistics for the same period. The assumption of the survey findings' representativeness across all camps in Cox’s Bazar relies on the notion that key camp characteristics—such as adult population demographics, time of arrival in the camps, and access to healthcare—are largely homogeneous. The surveyed camps are those supported by MSF OCP, where MSF provides limited monthly access to HCV treatment for individuals diagnosed at MSF-supported in-and outpatient services. If the surveyed camps were to introduce bias into the overall estimate of active HCV infection prevalence of all camps in Cox’s Bazar, it is more likely to result in an underestimation rather than an overestimation of the overall burden in the camps.

Conclusions and recommendations

The survey disclosed a high prevalence of HCV exposure and active infection among the FDMN population in Cox’s Bazar camps. Approximately one in five adults in the camps is estimated to be living with untreated HCV infection, emphasizing the urgent need for enhanced access to diagnosis and treatment. The burden affects the entire adult population, with women and older age groups being disproportionately impacted. Extrapolating the survey estimates to the entire adult population in the Cox’s Bazar camp (464,324 adults as per UNHCR camp population statistics in 2023) suggests that approximately 86,000 adults currently require treatment, after adjusting for the higher proportion of women included in the survey.

The findings emphasize the pressing need for additional stakeholders in the camps to intervene and support the scale up of access to diagnosis and treatment. Advocacy for the integration of HCV prevention, diagnosis, and care into the comprehensive healthcare package for the entire Cox’s Bazar camp community is crucial. Initiatives for HCV prevention should target identified gaps in awareness and knowledge about Hepatitis C within the population, while infection control efforts must strengthen prevention and safe medical practices across all healthcare sectors in the camps. Given the generalized HCV epidemic among the FDMN adult population in Cox’s Bazar camps, a strongly recommended course of action involves initiating a multi-partner task force and developing a strategic plan to treat all, aiming to prevent disease and halt further HCV transmission in the camps

TABLE OF CONTENT

TABLES

FIGURES

ABBREVIATIONS

aOR	Adjusted odds ratio
BUHS	Bangladesh University of Health Sciences
CI	Confidence interval
cOR	Crude odds ratio
DAAs	Directly-acting-antivirals
FDMN	Forcibly Displaced Myanmar Nationals
HCV	Hepatitis C Virus
HH	Household
MoH	Ministry of Health
MSF	Médecins Sans Frontières
OR	Odds ratio
NAAT	Nucleic acid amplification test
OCP	Operational Center Paris
RT-PCR	Reverse Transcription- Polymerase Chain Reaction
RDT	Rapid Diagnostic Test
RNA	Ribonucleic acid
RRRC	Refugee Relief and Repatriation Commission
TBA	Traditional birth attendant
WHO	World Health Organization

PROTOCOL DEVELOPMENT AND STUDY TEAM

Principle investigators	Name and Designations	Roles and responsibilities
	Birgit Schramm Epidemiologist Epicentre, Paris, France Email: Birgit.Schramm@epicentre.msf.org	Support study design Protocol finalization ERB submission Study implementation and coordination Support data management Data analysis Report and manuscript
	Md Hadiuzzaman Epidemiology Activity Manager* Medecins Sans Frontieres Email: hadi.zaman.md@gmail.com	Conceptualization and study design Protocol draft Local ERB submission Support communications
Co-investigators	Khondaker Ahsanul Ashakin Epidemiology Activity Manager MSF OCP, Cox's Bazar, Bangladesh Email: msff-coxsbazar-epi-manager@paris.msf.org	Support study design and protocol Field study implementation and coordination Data management Support data analysis Support report and manuscript
	Farah Hossain Deputy Cell Manager (Medical) Tokyo Cell, MSF-OCP, Japan Email: farah.hossain@tokyo.msf.org	Support study design and protocol Support data interpretation Support dissemination of findings Policy/operational decision-making
	Suna Balkan Hepatitis advisor Medical department MSF-OCP, Paris, France Email: suna.balkan@paris.msf.org	Support study design and protocol Support data interpretation Support dissemination of findings Policy/operational decision-making
	Wasim Firuz Project Medical Referent MSF OCP, Cox's Bazar, Bangladesh Email: msff-coxsbazar-pmr@paris.msf.org	Support protocol and local ERB submission Support to field implementation Medical oversight for participants Support data interpretation Support dissemination of findings Operational decision-making, policy
	Marve Duka Medical coordinator MSF OCP, Cox's Bazar, Bangladesh Email: msff-bangladesh-medco@paris.msf.org	Support protocol and local ERB submission Support to field implementation Medical oversight for participants Support data interpretation Support dissemination of findings Operational decision-making, policy
	Jihane Ben-Farhat Epicentre, Paris, France jihane.ben-farhat@epicentre.msf.org	Support sampling strategy Support data management and data analysis Support report and manuscript
	Anisur Rahman Laboratory Supervisor MSF OCP, Cox's Bazar, Bangladesh Email: msff-coxsbazar-lab-sup@paris.msf.org	Training surveyors' hepatitis C testing Laboratory-based HCV viral load testing
	Pradip Sen Gupta Professor and Head of Epidemiology Bangladesh University of Health Sciences (BUHS)	Protocol feedback Support submission for local ERB approval Feedback on study reports and manuscript/support advocacy with different

		stakeholders in relevant Bangladesh research institutions
Collaborator	Abu Toha MD. Rezuanul Haque Bhuiyan Health Coordinator Email: dr.tohabhuiyan@gmail.com Office of The Refugee Relief and Repatriation Commission, Cox's Bazar, Bangladesh Ministry of Disaster Management, Bangladesh	Support local authority approval Protocol feedback Support dissemination of findings/support advocacy with different stakeholders of the Cox's Bazar camp

* Previously with MSF OCP, Cox's Bazar, Bangladesh.

Collaborating partners

This survey was carried out in collaboration between MSF-OCP and Epicentre. The survey was funded by MSF-OCP. The protocol and survey procedures were developed by the principal investigators with feedback from co-investigators. Epicentre supervised the survey procedures, data collection, data analysis and writing of the final report. MSF study investigators in Bangladesh were responsible for field implementation, survey coordination, and data collection.

Bangladesh University of Health Sciences (BUHS) was a collaborating institution, with Professor Pradip Sen Gupta as co-investigator, providing scientific feedback to the study protocol, input on interpretation of the findings that will be provided in report format to all co-investigators, and support in communication of the findings in Bangladesh and internationally. Collaborator Dr. Abu Toha MD, Rezuanul Haque Bhuiyan, Health Coordinator at the Refugee Relief and Repatriation Commission's (RRRC) office in Cox's Bazar, supported the study by review of the study protocol and support in the dissemination of the survey findings, i.e. support of advocacy initiatives with different stakeholders of the Cox's Bazar camp on extending access to HCV care in the camps.

MSF is responsible for disseminating the results to the health and administrative authorities of the Cox's Bazar Camp, as well as to other stakeholders working in the camp in support of the FDMN population. MSF together with the local leaders and authorities will share the results with the camp community.

SURVEY DESIGN: SUMMARY TABLE

Title	Prevalence of active Hepatitis C (HCV) infection and associated risk factors among Forcibly Displaced Myanmar National population (FDMNP) residing in camps, Cox's Bazar, Bangladesh
Protocol version	V1.3 (29/04/2023)
Primary objective	To estimate the prevalence of active HCV infection (sero-positive and viremic) in the general adult FDMNP residing within camps.
Secondary objectives	○ To estimate the proportion of undiagnosed active HCV infections (individuals not aware of their HCV infection). ○ To estimate the prevalence of past/cleared HCV infection (individuals HCV sero-positive but non viremic). ○ To assess the associated risk factors of HCV infection for the Rohingya community people.
Study Design	Cross-sectional point-prevalence study
Sample size	680 individuals from 680 households
Study sites	Camps 8W, 12, 13, 16, 17, 18, 19, Cox's Bazar, Bangladesh
Duration	Data collection: 10th May and 14th June 2023
Implementing agencies	Médecins Sans Frontières, Operational Center Paris (MSF-OCP) 34 Av. Jean Jaurès, 75019 Paris, France Médecins Sans Frontières, Cox's Bazar Project, Bangladesh Epicentre, 34 Av. Jean Jaurès, 75019, FranceFrance
Funded by:	Médecins Sans Frontières, Operational Center Paris

1. BACKGROUND

1.1. Hepatitis C virus infection

Hepatitis C virus (HCV) is a bloodborne virus. Most infections occur through exposure to blood from unsafe injection practices during injection drug use or health care procedures, unscreened blood transfusions, or sexual practices that lead to exposure to blood. HCV causes both acute and chronic infection. Acute HCV infections are usually asymptomatic and about 30% (range: 15–45%) of infected persons spontaneously clear the virus within 6 months of infection without any treatment and without developing severe disease. The remaining 70% (range: 55–85%), if left undiagnosed and/or untreated, will develop chronic HCV infection, with 15% to 30% leading to serious and potentially life-threatening inflammation of the liver (cirrhosis) or hepatocellular carcinoma within 20 years [1].

Access to HCV treatment remains limited mainly due to insufficient access to HCV diagnosis, especially in LMICs, where 80% of HCV infections occur but fewer than 5% are diagnosed. Among people living with HCV infection in 2019, only about 21% knew their diagnosis, and of those diagnosed only around 62% received treatment [6]. In 2016, WHO set the target to eliminate HCV as a public health threat by 2030 [7]. WHO member states, including Bangladesh, are signatories to eliminate Hepatitis C virus infection by 2030.

1.2. HCV diagnosis and treatment

Anti-HCV antibodies usually remain detectable for a lifetime and indicate previous exposure with the virus, seropositivity thus indicates previous exposure. Active HCV infection is identified by a Nucleic acid amplification test (NAAT), that detects HCV viral load in blood. For people with active HCV infection, treatment is recommended. Early diagnosis is important as it can prevent serious health problems and further transmission of the virus. Diagnosis of active HCV infection is usually in 2 steps (“reflex testing”) [8]:

(1) Testing for anti-HCV antibodies with a serological test (possible with a rapid test, RDT), and
(2) If the anti-HCV is positive: NAAT for HCV ribonucleic acid (RNA) to confirm active HCV infection.

Importantly, recent pan-genotypic Direct-acting antivirals (DAAs) are highly effective (mostly sofosbuvir and daclatasvir), with high cure rates of HCV infection and short treatment duration (12 to 24 weeks), depending on the absence or presence of cirrhosis. In many low- and middle-income countries, the DAA treatment course could be available for less than $70.

1.3. Rohingya people residing in Cox’s Bazar camps

The Rohingya people of Myanmar are a Muslim ethnic minority group who have lived for centuries in predominantly Buddhist Myanmar, where they are not recognized as an official ethnic group and have been denied citizenship since 1982. An intensified assault by Myanmar authorities in Rakhine state in August 2017 forced hundred-thousands of Rohingya people to flee their homes, leading to an acute exodus of more than 700,000 Rohingya refugees crossing the border to Bangladesh, and the

expansion of massive refugee settlements in the district of Cox's Bazar considered the world's largest refugee camp [9] [10]. As of September 2023, 965'467 individuals (464 324 adults) of the Rohingya or Forcibly Displaced Myanmar National (FDMN) people are residing in densely crowded camps located in Cox's Bazar district. The vast majority (approx. 80%) arrived in 2017.

MSF OCP has a long history in Bangladesh, starting with the response to the 1991/92 influx of Rohingya refugees, but pulled out of the country in 1995. More than 20 years later, following the massive exodus of Rohingya fleeing Myanmar, OCP opened dedicated medical services to the population in October 2017. Currently, MSF OCP runs one Primary Health Care Center, one general OPD, and one specialized clinic in Cox's Bazar camp. The "Hospital on Hill" (located in camp 8w) provides emergency care, adult intensive care unit (ICU), and inpatient department (IPD) support, as well as a sexual and reproductive health (SRH) project that provides antenatal- and postnatal care (ANC and PNC), family planning, and sexual and gender-based violence (SGBV) care. OPD3 (health post, also located in Camp 8w) provides general outpatient services, and non-communicable diseases – (NCD), Mental Health and Hepatitis C care. The OPD2 (in Camp 13) is a specialized clinic for NCD and Mental Health. OCP also has a facility outside of the camp, Goyalmara Mother & Child Hospital (near Camp 16) provides specialized care for neonates, pediatrics, and pregnant mothers, as well as Mental Health and SGBV support to the beneficiaries.

1.4. Hepatitis C in the Cox's Bazar camp

Recent data indicated an alarming and unexpectedly high proportion of HCV seropositivity among FDMN population in the camps, with 8% HCV seroprevalence among 300 conveniently selected pregnant women [5], 9% HCV seropositive among 275 samples analyzed during an outbreak investigation of Acute Jaundice Syndrome (AJS) in 2018 [4], and 11% HCV seropositive among children age ≥ 7 years and adults, with 22% seroprevalence among adults reported in a larger seroprevalence survey conducted by the Medical University of Dhaka in 2019 [5]. Information on active HCV- infection is lacking. A small pilot survey in 2019 in one camp (Lambasia) detected 13.2% HCV RNA positivity in 53 blood samples [3].

Since October 2020, MSF OCP has been providing Hepatitis C treatment and care, free of charge for the refugee population residing in Cox's Bazar, with screening and diagnosis (of patients presenting with chronic diseases in MSF-supported outpatient and inpatient facilities in the camps) with a simplified treatment algorithm and treatment delivery model. Main criteria for screening among patients presenting in the health care facilities are age>40 years and/or signs and symptoms of decompensated Liver diseases, a partner living with active HCV infection, or being followed in the MSF NCD or Mental health cohorts. The capacity of OCP treatment program has a maximum quota of 150 new patients needing treatment per month. In addition, MSF operational center Brussels (OCB) - provides HCV testing and treatment free of charge since October 2020, mainly in camps 14 and 15.

2. RATIONAL

Limited available data indicated an unusually high HCV seroprevalence among the FDMN Community in Cox's Bazar Camps in Bangladesh. Representative seroprevalence data and information on active

HCV- infection and risk factors for HCV infection in the camps was lacking. A well-designed, representative study was needed to assess the prevalence of active HCV infection and its associated risk factors in the camps. The expected impact of this survey was:

(1) to provide information on the target population and estimated number of people who may require diagnosis and treatment,
(2) to inform tailored interventions for prevention and diagnosis, and
(3) to generate robust data to advocate for the need to integrate HCV prevention/diagnosis and care into the general package of health care for the entire Cox's Bazar camp community, and involvement of other actors.

3. OBJECTIVES

3.1. Primary objective

The primary objective was to estimate the prevalence of active HCV infection (seropositive and viremic) in the general adult FDMN population residing within camps.

3.2. Secondary objectives

Secondary objectives of the study were:

1. To estimate the proportion of undiagnosed active HCV infections (individuals not aware of their HCV infection).
2. To estimate the prevalence of past/cleared HCV infection (individuals HCV seropositive but non viremic).
3. To describe the sociodemographic characteristics of participants with past/cleared HCV infection and current active HCV infection.
4. To assess factors associated with HCV infection in the FDMN population.

4. METHODS

4.1. Survey design

Cross-sectional, point prevalence survey.

4.2. Study site

The survey was conducted in seven camps: 8W, 12, 13, 16, 17, 18, and 19, located at the center of camps in Ukhia, Cox's Bazar District, Bangladesh (**Figure 1**).

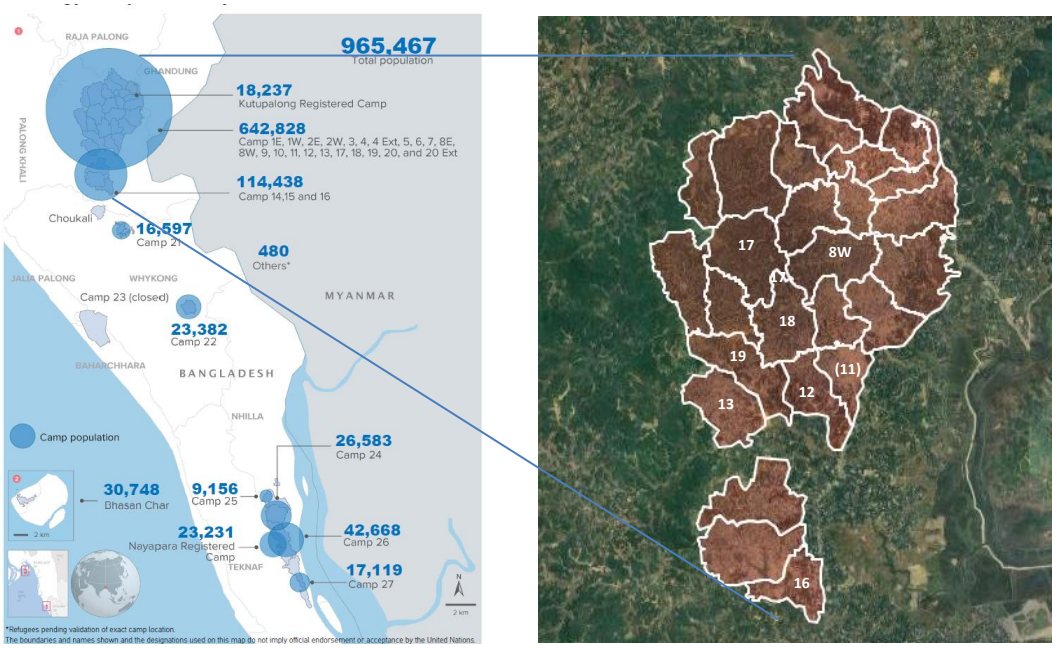
The MSF OCP catchment area in the Cox's Bazar camps is comprised of eight camps: 8W, 11, 12, 13, 16, 17, 18, 19. In March 2023, a massive fire broke out in camp 11 and destroyed about 2000 shelters and affected/displaced approximately 12'000 individuals (of total 32 200 population in this camp). The sampling strategy of the survey was based on randomly selected GPS coordinates that co-localize with visible roof-structures on satellite images of the targeted camps. To this end, camp 11 could not be included in the survey as initially foreseen.

4.3. Target population

Adult members of the FDMN (Forcibly Displaced Myanmar National) population residing in one of seven selected camps (8W, 12, 13, 16, 17, 18, 19) Cox's Bazar District, Bangladesh. As per UNHCR statistics, 42'008 families and 98'234 adults (52 999 male and 45235 female) were residing in the seven camps in 2023 [11].

Figure 1. Map of Rohingya Camp in Cox's Bazar District, Bangladesh

A B



A: UNHCR September 2023 [11].

B: Study sites: seven of eight OCP-supported camps (camp 11 not included in survey); Google Earth satellite image (30 January 2022), and delimitation-polygons representing the respective camp outlines, available through OCHA services [12]

4.4. Inclusion criteria

- Age ≥18 years
- Registered resident in Camp 8W, 12, 13, 16, 17, 18, or 19

- Member of a randomly selected household (registered under a Family card in the respective household)
- Willing and able to provide written consent.

4.5. Sampling strategy

Overall sampling method

Simple probability sampling, using geospatial sampling methods was applied.

Definition of sampling unit "household"

The sampling unit of the survey was the "household (HH)", defined as an individual roofed shelter in the camp inhabited by one -, or in some cases, two to three closely related families. Each family member is registered under a "family card", with a unique family card number (FCN). The survey considered all individuals who live under the same roofed structure and are registered with one of the family cards assigned to this shelter as **"**household members". Temporary visitors (not registered with any of the family cards of the household) were not included in the survey.

Geospatial sampling

The Epicentre inhouse application "Geosampler" was used to randomly identify 680 HHs in the seven camps, pre-identified through random selection of GPS coordinates that co-localized with visible roof-structures on the latest available satellite image of the Bazar camps (Google maps, Cox's Bazar, updated 30 January 2022), and by using available delimitation-polygons representing the respective camp outlines, available through OCHA services [12].

Selection of one eligible individual per HH

In each HH, one household member was randomly selected among all members who met the survey eligibility criteria by use of a random number application on the tablet. In case of absence of a randomly selected HH member, the surveyor team was instructed to book a return date within the same week to aim for inclusion of the selected HH member. Maximal one catch-up visit per household was foreseen. If a given HH or a selected individual refused to participate or was absent for more than 3 days coming days, the respective HH/individual was to be excluded from the sample without being replaced by another HH or family member.

4.6. Sample size

The survey sampled participants from seven camps (8W, 12, 13, 16, 17, 18, 19), comprising the MSF OCP catchment area in Cox's Bazar camps. At the time of the protocol writing, 434'279 adults (188'669 families) of the FDMN Population were residing in 26 densely crowded camps, and 109,389 adults (47,276 families) in the 7 OCP-supported camps (UNHCR Population Factsheet Block Level Data, Cox's Bazar (31July 2022).

Since no representative estimates were available on the prevalence of active HCV infection in the general adult FDNM community in Cox's Bazar camp, we assumed a prevalence of active HCV infection anywhere between 10-35%, and the higher margin (35%) was chosen to ensure sufficient precision for the prevalence estimate. To report a prevalence-estimate of active HCV infection of up to 35% with a

95% confidence interval and a precision of +/- 4.0%, N=540 HHs (N=540 individuals) needed to be surveyed. After adding 25% to account for 5% technical issues and 20% absentees or refusal, N=680 HHs (136+544, rounded to 680) were targeted **(table 1).**

Table 1 Sample size calculation

Total number adults residing in the seven camps	94,163*
Estimated proportion of adults with active HCV infection	35%
Confidence level (1-alpha)	95%
Confidence interval width	+/- 4.0%
Number of HHs (individuals) to be surveyed	**N=543**
Additional HHs to account for 5% technical issues with HCV testing	N=27
Additional HHs to account for 20% absentees or refusal	N=109
Total HHs to be surveyed (rounded to the next decimal)	**N=680**

* Source: UNHCR population fact sheet Cox's Bazar, updated 31 July 2022 [13].

The sample size was computed using PASS 14 Power Analysis and Sample Size Software (2015) (NCSS, LLC. Kaysville, Utah, USA, ncss.com/software/pass), using "Confidence intervals for one Proportion from a finite population".

Sampling frame and PPS method

Since the exact number of HHs (see definition above) in the camp was unknown, the number of families per camp was used as a sampling frame (source: UNHCR population fact sheet 31 July 2022). The N=680 HHs were sampled proportionate to the number of families in each of the seven camps, following the probability proportional to size (PPS) method (**table 2**).

Table 2 Sampling frame and number of households targeted per camp- as per PPS method

OCP-supported Camps	**Total Families***	**Total Adult population Female***	**Total Adult population Male***	**Total Adult population***	Proportion of families	Number of HHs to be sampled by Camp (N)
Camp 8W	6,560	8,119	6,987	15,106	0.16	**108**
Camp 12	5,568	7,312	6,050	13,362	0.14	**93**
Camp 13	8,973	11,280	9,623	20,903	0.22	**146**
Camp 16	4,572	5,542	4,888	10,430	0.11	**75**
Camp 17	3,953	4,643	3,847	8,490	0.10	**65**
Camp 18	6,221	7,448	6,170	13,618	0.15	**101**
Camp 19	5,185	6,684	5,570	12,254	0.13	**92**
Total, N	**41,032**	51,028	43,135	94, 163	1.00	**680**

*Source: UNHCR population fact sheet Cox's Bazar, updated 31 July 2022 [13].

4.7. Data collection

4.7.1. Participant inclusion and overview of survey activities

1. Identification of the HH using the pre-identified GPS points
2. Verbal authorization to conduct the survey in the household from the head of HH or his/her representative.
3. Head of HH questionnaire
4. Compilation of the list of HH members and list of eligible individuals in the HH.
5. Random selection of one eligible participant among all eligible adult members of the HH.
6. Confidential information giving and written informed consent of randomly selected HH member.
7. A unique survey ID was assigned to each consenting participant.
8. Collection of fingerpick samples and anti-HCV rapid test on the spot.
9. Administration of a participant questionnaire, to collect socio-demographic information and to assess for factors potentially associated with previous or active HCV infection.
10. For participants with a reactive anti-HCV test: a 6 ml venipuncture sample was collected to test for active HCV infection (viremia, VL ≥ 1000 IU/ml)) in the MSF lab. The participant was provided a VL result pick up date in the OCP HCV project in the camps to ensure linkage to care.

If a selected individual refused or was absent at the time of the survey and during a follow up visit, the respective participant (and HH) was excluded from the survey without replacement by another eligible member of the same HH, or by another HH.

4.7.2. Blood collection and HCV diagnosis

Screening for HCV seropositivity was done by use of a rapid test (HCV SD Bioline, Standard Diagnostics, immunochromatographic anti HCV test, LOT N^{o} 02BDG025A) for the detection of antibodies against Hepatitis C virus. During the HH visit, the study nurse collected a few drops of capillary blood from a fingerprick to perform the RDT test on the spot. Results were directly shared with and explained to participants during the household visit, ensuring confidentiality.

For all survey participants with a reactive anti-HCV test, the nurse collected a venepuncture blood sample (about 6ml) into ethylenediaminetetraacetic acid (EDTA). The blood samples were stored at 2-8°C in EPI passive cold chain boxes and transported to the MSF laboratory of “Hospital on the Hill”, inside the camp, at the end of each survey day. The samples were centrifuged within 8 hours of collection and the tested for HCV RNA (ribonucleic acid) Viral Load (VL) using Xpert® HCV Viral Load test (Cepheid, RT PCR assay, LOT N^{o} 36704).

4.7.3. Survey questionnaires

Two types of questionnaires were filled: a brief household questionnaire, and a comprehensive participant questionnaire. The participant questionnaire was administered in Rohingya language by trained survey staff, supported (if required) by the survey volunteer from the Rohingya community.

The questionnaire was pre-tested for comprehensiveness and appropriateness of language with volunteers from the FDMN population and MSF clinical staff in the HCV program and was subject to minor modifications during staff training and pilot study.

The following information was recorded into the survey database:

1/Household Questionnaire

- Sex, age of head of household or representative
- Number, sex, age of eligible members in the HH
- Random selection of one eligible HH member

2/ Participant Questionnaire

Participant socio-demographic information

- Sex
- Age
- Year arrived in Cox's Bazar
- Highest grade of education
- Member or visitor of household
- Marital status

HCV: Questions on knowledge of Hepatitis C

HCV: History of Hepatitis, Diagnosis, and Treatment

- Previous diagnosis
- Previous treatment

HCV: factors that facilitate hepatitis C transmission/ exposure to risk factors

- Shared HH items
- Contact with hepatitis infected people
- Tattoos
- Barbershop/ beard razor
- Manicure/Pedicure in shops
- Medical injections
- Blood transfusion or donations
- Dental or gum treatment
- Surgeries
- Circumcision
- Obstetric history/women's health (birth, abortion)
- Sexual activity
- Exposure to sexual violence
- Injection drug use/sharing of needles

HCV tests results

- HCV antibody rapid test result
- HCV viral load test result if HCV antibody positive

For participants who opted to report exposure to sexual violence, the study nurse and surveyor were sensitized to provide information on optional referral to the MSF sexual reproductive health and sexual gender-based violence service (SRH/SGBV) in the camp to receive support if needed.

4.7.4. Data collection tools

At inclusion, a unique survey ID was assigned to each consenting participant. All study data (socio-demographic information of the participating HH and individual, HCV RDT results, participant questionnaire responses) were directly recorded into an electronic study database by trained surveyors using password-protected Android tablets (exclusively study-dedicated devices) and Kobo Collect© software, based on the open source ODK Collect app [14]. Surveyors had password-protected user accounts of Kobo Collect. MAPME software application was installed on the surveyor tablets offline (without connection to the internet in the camp) to allow for the identification of the geo-localization data points used for the identification of randomly chosen households. For survey data analysis the HCV VL results of the HCV VL result database were merged with the questionnaire data collected, using the study ID as the unique identifier.

An HCV VL result database (Kobo software) was set up to record Xpert HCV VL results received from the MSF laboratory. For data analysis, a de-identified HCV VL database, without personal identifiers was merged with the main survey database. All personal identifiers in the HCV VL result database were kept strictly separate from the study database and were only provided to dedicated MSF routine medical staff for the purpose of linkage to care (using name, family card number and address, and phone number (if provided by the participant)).

4.8. Data management and analysis

During the survey, the data was uploaded daily from data collection tablets to KoboCollect and the secure MSF Server by the study coordinator. Before analysis, databases were cleaned by consistency checks and identification of data entry errors or missing data. All errors, missing data or discrepancies were investigated to ensure validity and accuracy of data. Data were analyzed using STATA software (College Station, Texas, USA).

Participants' sociodemographic and risk factor exposure characteristics were described with proportion, median, interquartile range [IQR], or mean and maximum and minimum, respectively.

Main outcomes were HCV seroprevalence and prevalence of active HCV infection. These prevalence estimates were corrected by assigning a 'weight' to each individual participant, corresponding to the total number of eligible individuals in the respective HH (weighting adjusts for differences in probability to be selected as a participant with the number of eligible differing between HHs). Survey-adjusted prevalence estimates were provided as proportions with their 95% confidence intervals (95%CI). Where appropriate, differences in proportions are assessed using Pearson chi2 test or Fisher's exact test and p-value (p) were presented.

Identification of potential risk factors of previous HCV exposure or active HCV infection were assessed by univariate- and multivariate logistic regression. Crude and adjusted odds ratios (ORs) are presented with 95%CIs. Variables with a p-value of ≤0.2 in univariate regression analysis were integrated into a multivariate model, and variables with a posteriori p-value of ≤0.05 were retained in the final model.

5. ETHICAL CONSIDERATIONS

5.1. Authorisations

The survey protocol (version 1.3) was approved by the MSF Ethical Review Board (MSF ERB No 2287), and the Bangladesh University of Health Sciences (BUHS) (number: BUHS/ERC/EA/22/46).

The survey also received written approval from the Ministry of Health (i.e., The Civil Surgeon office Cox's Bazar) and The Office of the Refugee Relief and Repatriation Commissioner (RRRC, government agency under the Ministry of Disaster Management and Relief responsible for providing relief to Rohingya refugees in Bangladesh and in Cox's Bazar camp).

5.2. Informed consent

Verbal agreement from the head of household, or his or her legal representative, was sought before starting the survey and before selection of a survey participant. Verbal agreement was documented by signature of a survey team member into the household consent form.

Signed informed consent was required for survey participants. The surveyor, assisted by the community volunteer, explained the details of the survey, as per participant information sheet**.** A witness was required to attend the consent and co-sign the consent form for illiterate people (a literate person who understands the Rohingya language and chosen by the participant). Given the high illiteracy rate among the camp population, the survey volunteer from the Rohingya community could also serve as witness if the participant agreed. The surveyor team and community volunteers were trained on the consenting process to ensure that the potential participants' decision to accept or refuse to be part of the study were respected. A copy of the information sheet and the signed informed consent form were provided to each participant.

5.3. Confidentiality and data protection

All survey team members were trained in good clinical practices (GCP) in research, including data protection and confidentiality. Data collected into the electronic study databases (KoBo Collect and HCV VL test lab database) were coded using an individual alpha-numeric study ID. Participant names were not recorded into the study database that was used for analysis; only de-identified data were entered into the electronic questionnaires. Study laptops, Android tablets and the electronic database were password-protected, and access was only to trained and authorized study staff. Any paper documents associated with the study were stored in a secured room at the MSF office in Cox's Bazar and destroyed after 5 years. The central electronic database is password protected and will be stored on a secure server at Epicentre in France for 5 years after the survey and then permanently deleted.

Remainders of blood specimen sent to the MSF laboratory in the Hospital on the Hill in the camp for HCV VL test were destroyed.

5.4. Linkage to care of participants identified with acute HCV infection

Participants identified with active HCV infection during the survey were linked to the routine MSF HCV treatment program at the Hospital on the Hill in the camp, including counselling, treatment and follow up free of cost. To ensure linkage to care, all participants who tested HCV seropositive received a paper slip with the participant's unique study ID and an appointment date to pick up the HCV VL result about one month after the survey participation at the MSF HCV treatment centre in OPD 3 at the Hospital on the hill. Partners of participants identified with active HCV infection during the survey were given priority access to HCV testing by the MSF routine programme.

6. FIELD IMPLEMENTATION

6.1. Community awareness

After having received approval from the ERBs and the RRRC (Office of the Refugee Relief and Repatriation Commissioner) and the Cox's Bazar Civil surgeon office (Ministry of Health), the proposal and justification of the HCV prevalence survey was communicated and discussed with the camp leader in charge, camp health focal point, and at a second step with leaders of the camp community (Majhi), including religious leaders, in two different sessions to ensure that the design and purpose of the study is well understood. Community volunteers who were part of the survey team informed respective camp block leaders during the week before the survey start in detail about the beginning of the activity.

6.2. Surveyor teams, training, and pilot survey

Eight surveyor teams were assembled, each consisting of 3 members: one surveyor, one nurse, one survey volunteer from the FDMN community. An effort was made to have at least one female staff in each team, to accommodate culture context when interviewing women. The volunteer from the FDMN community facilitated communication and acceptability of the survey, as well as translation during informed consent or the participant interview. The survey was conducted during daytime hours and weekdays Sunday to Thursday.

Before the start of the survey, in the beginning of May 2023, survey team members participated in a six-day training, comprised of the following theoretical and practical training elements:

- Introduction to MSF and OCP project activities in Cox's Bazar camps
- Familiarization with the study protocol and objectives
- Sampling and Survey procedures
- Administration of informed consent
- GCP, research ethics, privacy and confidentiality
- Participant inclusion

- Administration of the participant questionnaire
- Practical training on data collection using KoboCollect software on tablets
- Practical training on Blood collection, storage and transport using blood samples in EDTA tubes
- Practical training on conduct of HCV rapid test using fingerprick blood sample
- Infection prevention and control in the workplace, including management of needlestick injuries and post-exposure prophylaxis protocol

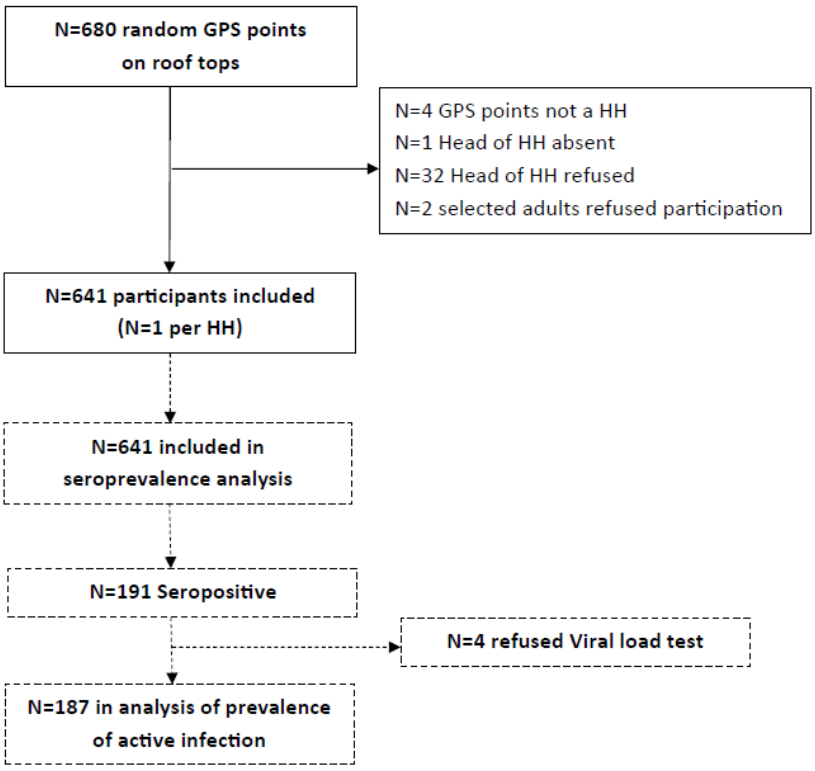
The training was followed with a pilot survey in camp 8W, which included 14 individuals from 14 HHs. Written informed consent form was obtained from all pilot survey participants, and those identified as HCV seropositive in the pilot were asked to provide a sample for HCV VL testing and were referred to pick up their results for linkage to care, similar to the actual survey procedures. Four pilot participants (28.5%) tested HCV seropositive, and 3 of these (75%) had an HCV viral load detected (active infection). Pilot data were not included in the final analysis.

7. RESULTS

7.1. Included households and participants

The survey was conducted between 10th May and 14th June 2023, including 641 individuals from 641 households (HHs). Among the provided 680 random roof-top positioned GPS-points in the seven camps, 4 GPS-points did not correspond to a HH, one head of HH was absent, 32 head of HHs and two randomly selected HH members refused survey participation (**figure 1**).

Figure 1 Survey inclusion scheme



The total survey sample was distributed proportionate to adult population size per camp in the sampling strategy. The proportionate representation was preserved in the final sample of 641 individuals included in the survey (**table 3**).

Table 3 Number and percentage of adults included per camp

	Survey sample		Camp population (UNHCR Sept 2023)	
Camp	Adults included, N	**% of total**	Adults, N	**% of total**
8W	101	**15.8**	15808	**16.1**
12	90	**14.0**	13931	**14.2**
13	134	**20.9**	21700	**22.1**
16	72	**11.2**	10716	**10.9**

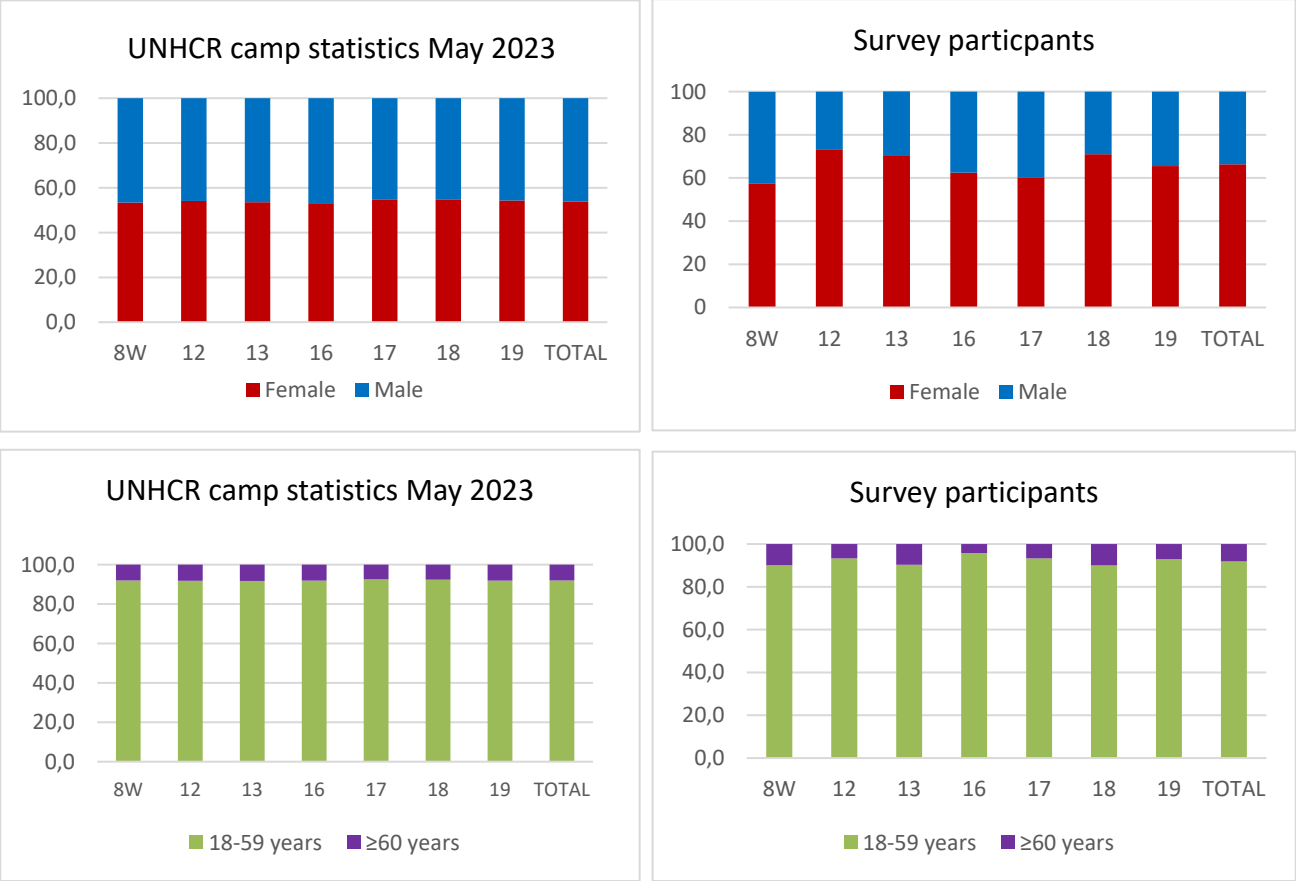
17	60	**9.4**	8928	**9.1**
18	100	**15.6**	14210	**14.5**
19	84	**13.1**	12941	**13.2**
Total	641	**100**	98234	**100**

7.2. Sociodemographic characteristics of participants

Two-thirds of participants were women (66.3%), the median age was 34 years [IQR: 28, 46] (**table 4**); The median age of male was 37.5 years (31.0-51.5) and the median age of women 32.0 years (26-46) years, respectively.

8.1% (52/641) of participants were aged ≥60 years (not tabulated), matching the camp UNHCR population statistics [15], with 8% aged ≥60 years in the seven camps, and 8% in all camps, respectively. Notably, camp statistics showed somewhat lower proportion of female, with 53.9% female adults in the seven surveyed camps and 54% in all camps, respectively (UNHCR population statistics, Cox's Bazar camps, May 2023) (**figure 2**).

Figure 2 Sex and age distribution- survey versus camp statistics



All participants were born in Myanmar, and the median time since arrival in the Cox's Bazar camps was 5.7 years (no difference by camp, not shown). Most participants (93.1%) shared a household with at least one other adult, 85.0% indicated living in a couple or being married. Almost all (93.2%) male participants living with a partner or married indicated having only one single spouse, 4.1% reported having two spouses, 2.8% reported three spouses.

Frequent self-reported chronic diseases (probed) included heart disease (8.2%) (details of heart disease not further specified in the questionnaire) and diabetes (7.7%). Notably, 11 participants (all female) reported "Hepatitis C" (non-probed) when asked about any other current chronic disease; 10 of these tested HCV seropositive, and five were HCV viremic.

Table 4 Sociodemographic characteristics of participants

Participants, N	641
Female, N (%)	425 (66.3)
Male, N (%)	216 (33.7)
Age, median [IQR] (years)	34 [28, 46]
Age categories (years), N (%)	
○ 18-24	87 (13.6)
○ 25-34	239 (37.3)
○ 35-44	129 (20.1)
○ 45-54	93 (14.5)
○ 55-64	93 (14.5)
○ ≥65	31 (4.8)
Born in Myanmar, N (%)	641 (100)
Years since arrival in the camps, median [IQR]	5.73 [5.69-5.7]
Religion Muslim, N (%)	641 (100)
Number of adults in HH, N (%)	
○ 1 adult	62 (9.7)
○ 2 adults	400 (62.4)
○ 3-5 adults	150 (23.4)
○ >5 adults	29 (4.5)
Marital status, N (%)	
○ Single	26 (4.1)
○ Married or living in a couple	545 (85.0)
○ Separated or widowed	68 (10.6)
○ Refused answer	2 (0.3)
Education, N (%)	
○ Never attended school	493 (76.9)
○ Primary level	93 (14.5)
○ Intermediate level	46 (7.2)
○ Higher level	6 (0.9)

○ *missing*	3 (0.5)
Away from camp during past 12 months, N (%)	
○ Never away	629 (98.1)
○ < 1 month	8 (1.3)
○ >1 month	2 (0.3)
○ *missing*	2 (0.3)
Self-Reported chronic diseases (*probed*) , N (%)	
○ Heart disease	52 (8.2)
○ Diabetes	49 (7.7)
○ Asthma	17 (2.7)
○ COPD	11 (1.7)
○ Depression	8 (1.3)
○ Liver disease	8 (1.3)
○ Kidney disease	3 (0.5)
○ Cancer	1 (0.2)
○ Substance abuse	2 (0.3)
○ HIV	2 (0.3)
○ Hypertension[§]	15 (2.3)
○ Gastritis[§]	6 (0.9)
○ Hepatitis C [§]	11 (1.7)

[§] Unprobed self-reports, following the question whether the participant has "any other type of chronic disease, that was not mentioned [in the questionnaire]".

7.3. HCV seroprevalence

All 641 participants were tested on the spot for HCV seropositivity (presence of HCV antibodies) with a rapid diagnostic test using a finger prick blood sample. 191 tested seropositive, resulting in a survey-adjusted estimate of **29.7% (95% CI: 26.0-33.8) HCV seroprevalence**.

An adjusted seroprevalence estimate corrected for a slightly higher proportion of women included the survey sample compared to the UNHCR camp population statistics (66.3% versus 54.0%, respectively) corresponds to **28.4 % (95% CI: 24.7-32.3) HCV seroprevalence.**

The HCV seroprevalence estimate was higher for female than male (32.8% versus 22.1%), and lower for the youngest age group (18-34 years). The HCV seroprevalence estimate also varied by camp, with significantly lower prevalence in camp 17 (8.5%), and highest in camp 12 (45.9%, non-significantly different from the estimates of the remaining camps) (**tables 5 and 6, Figure 3**). The seroprevalence estimate for women of reproductive age (<50 years) was 31.8 % (26.7-37.4). It should be noted that the survey sample was not specifically powered to identify significant differences in HCV seropositivity by camps, and accordingly confidence intervals are wide (table 6).

Table 5 Survey-adjusted HCV seropositive estimates -by sex and age group

	N included	Estimated % **HCV seropositive** (95% CI)	p-value (chi2)
Total	**641**	**29.7 (26.0-33.8)**	
Sex			0.007
Male	216	22.1 (16.8-28.5)	
Female	425	32.8 (28.1-37.9)	
Age (years)			0.024
18-24	87	13.8 (7.3-24.5)	
25-34	239	29.1 (23.3-35.7)	
35-44	129	36.4 (27.8-45.9)	
45-54	93	31.9 (22.2-43.5)	
55-64	62	35.5 (23.2-50.1)	
>65	31	38.1 (20.4-59.8)	

Figure 3 Survey adjusted HCV Seroprevalence estimates with 95% confidence interval, by sex

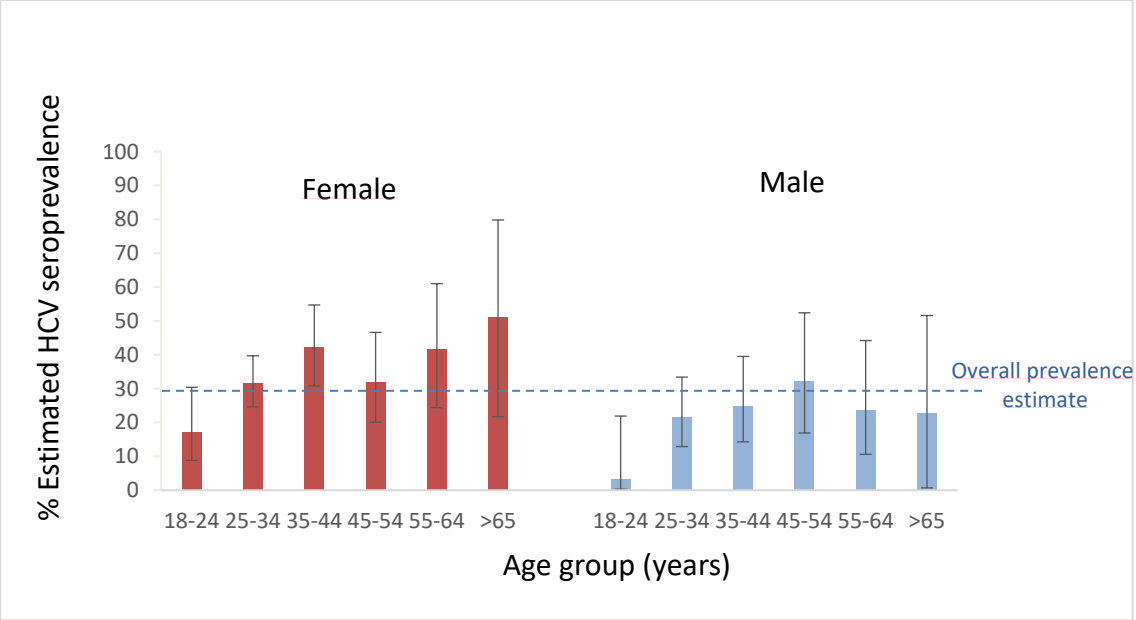


Table 6 Survey adjusted HCV Seroprevalence estimates, by camp

Camp	N included	**Estimated % HCV seropositive** (95% CI)
8W	101	25.0 (16.5-35.9)
12	90	45.9 (34.7-57.5)
13	134	28.4 (20.6-37.9)
16	72	32.5 (22.1-45.0)
17	60	8.5 (3.4-18.3)
18	100	29.8 (20.9-40.5)
19	84	33.0 (23.1-44.6)

7.4. HCV viremic ratio and prevalence of active HCV infection

7.4.1 HCV viremic ratio

HCV viremic ratio (or 'viremic rate') is the proportion of individuals with active HCV infection/viremic infection (HCV VL positive) among HCV seropositive.

Among 191 HCV seropositive participants, 187 had an HCV viral load (VL) test to assess the presence of active HCV infection (four HCV seropositive participants refused venous blood collection for HCV VL testing). Among 187 tested, 124 had a detectable VL (active HCV infection), resulting in a survey-adjusted viremic ratio of 66.6 % (95%CI: 58.9-73.6) among HCV seropositive. Estimates of viremic ratio by sex, age group and camp, are depicted in **table 7**. A significant difference of viremic rate by age

group was observed, with a lower than the overall average ratio among age groups 35-<50, and higher among youngest (18-24 years), and particularly high viremic ratio for the oldest age group (>65 years), respectively.

The median VL among viremic participants was 638 000 IU/ml (IQR: 192 500, 1845 000); all had a VL ≥ 1000 IU/ml, and 98.4% (122/124) had a VL ≥ 3000 IU/ml.

Table 7 Survey-adjusted viremic ratio among HCV seropositive – by sex and age group

	Estimated % **Viremic ratio among HCV seropositive** (95% CI)	p-value (chi2)
Overall	**66.6 % (58.9-73.6)**	
Male	72.8 (57.0-84.4)	0.128
Female	65.0 (55.8-73.2)	
Age (years)		
18-24	77.8 (30.0-96.6)	0.0208
25-34	73.5 (60.7-83.2)	
35-44	58.2 (42.0-72.8)	
45-54	53.3 (32.7-72.9)	
55-64	62.8 (37.3-82.8)	
>65	89.5 (37.9-99.2)	
Camp		
8W	68.6 (44.0-85.9)	0.677
12	60.2 (42.8-75.3)	
13	75.3 (55.0-88.4)	
16	65.4 (41.3-83.6)	
17	82.4 (17.5-99.0)	
18	67.6 (45.6-83.9)	
19	61.4 (40.5-78.8)	

7.4.2 Prevalence of active HCV infection

The survey-adjusted prevalence **estimate of active HCV infection** (HCV seropositive and viremic) among the general adult FDMN population was **19.6% (95%CI 16.4-23.2).** The estimated prevalence of active HCV infection among adult women of reproductive age (<50 years) was 19.8% (15.5-24.8). An estimated 9.8 % (7.5-12.6) of the overall adult population have been exposed to HCV infection and were no longer viremic (**table 8**).

An adjusted estimate of active HCV infection corrected for a slightly higher proportion of women included the survey sample compared to the UNHCR camp population statistics (66.3% versus 54.0%, respectively) corresponds to **18.9 (95%CI 15.8-22.4).**

Summary tables (**tables 9 and 10**) depict both HCV Seroprevalence and HCV Viremic prevalence, by sex and age group, as well as by camp. HCV The survey was not specifically powered to identify significant differences in the prevalence of active HCV infection between camps.

Table 8 HCV active versus cleared infection

	n/N	Survey adjusted estimates % (95% CI)
HCV sero-positive	191/641	29.7 (25.9-33.8)
○ HCV seropositive & viremic	124/637*	19.6 (16.4-23.2)
○ HCV seropositive & non-viremic	63/637*	9.8 (7.5-12.6)

* N=4 HCV seropostives without HCV VL test excluded from denominator

Table 9 Survey adjusted estimates of HCV Seroprevalence and active infection, by sex and age group

	Estimated prevalence **HCV seropositive** (95% CI)	Estimated prevalence of **Active HCV infection** (95% CI)
Overall	**29.7 (26.0-33.8)**	**19.6 * (16.4-23.2)**
Female	32.8 (28.1-37.9)	21.1 (17.1-25.7)
Male	22.1 (16.8-28.5)	15.8 (11.4-21.6)
Age group (years)		
18-24	13.8 (7.3-24.5)	10.0 (0.5-20.1)
25-34	29.1 (23.3-35.7)	21.1 (16.0-27.3)
35-44	36.4 (27.8-45.9)	21.2 (14.4-30.0)
45-54	31.9 (22.2-43.5)	17.0 (10.1-27.3)
55-64	35.5 (23.2-50.1)	22.3 (12.6-36.4)
>65	38.1 (20.4-59.8)	32.0 (15.3-55.2)

**Denominator: N=187 with RDT test and available HCV VL test (N=4 HCV seropositive refused venous blood collection for HCV VL testing)*

Table 10 Survey adjusted estimates of HCV Seroprevalence and active infection, by camp

Camp	Estimated prevalence **HCV seropositive** (95% CI)	Estimated prevalence **Active HCV infection** (95% CI)
8w	25.0 (16.5-35.9)	17.2 (10.1-27.6)
12	45.9 (34.7-57.5)	27.6 (18.5-39.2)
13	28.4 (20.6-37.9)	20.4 (13.6-29.6)
16	32.5 (22.1-45.0)	21.3 (13.4-32.1)
17	8.5 (3.4-18.3)	7.0 (2.8-16.3)
18	29.8 (20.9-40.5)	19.7 (12.5-29.7)
19	33.0 (23.1-44.6)	20.2 (12.4-31.2)

7.5. Participant characteristics: HCV exposure risks

The survey questionnaire also assessed participant's exposure to known transmission risks for HCV infection, including sharing of personal HH items, medical procedure(s) and/or cosmetic treatments involving sharps (nail treatments, shaving, piercings, tattoos), needle sharing, sexual violence, or intravenous drug use (IDU) (the latter three were considered sensitive topics, and addressed accordingly by trained surveyors) (**tables 11-13**). Association with HCV seroprevalence was explored in 2by2tables and chi2 or Fisher exact tests (shown), and findings described below (**see also figures annex 12.1**.):

Univariate associations identified with HCV prevalence:

- **Medical injections(s) were reported by many (70.4%),** 97.8% in the camps, and 66.0% in Myanmar. **HCV seroprevalence was significantly higher among those reporting injections than those who did not (32.6% vs 22.0%, Fisher's exact, p=0.009).** Injections were reported in hospital (90.8%), by traditional healers (66.9%), at the pharmacy (22.6%) or through TBAs (8.5%). HCV seropositivity did not differ significantly by location nor provider (not shown).

- **Surgery was reported by few (3.3%)**, and mainly at hospital (90%); 35% reported surgery in the camp, 40% in Cox's Bazar City, and 35% in Myanmar (HCV seropositivity did not differ significantly by location (not shown)). **Notably**, **HCV seropositivity was about twice as high among those reporting surgery than those who did not (61.9% vs 28.9%, chi2, p=0.001)**

- **Blood transfusion was only reported by eight participants (N=7 female)** (four in the camp, four in Cox Bazar, one in both locations, one in Myanmar). **Notably, 75% (6/8) tested HCV seropositive** (three among four who reported transfusion in the camps or in Cox's Bazar city, respectively, and one who reported transfusion in Myanmar), versus 29.3% who reported no transfusion (Fisher's exact, p=0.014).

- **Re-use of someone else's needle was reported by few (5.2%),** with 33.3% HCV seropositivity among those who re-used needle(s), 28.2% among those who did not, and interestingly

61.3% among those who reported "don't know" (three refused the answer, seronegative), (fishers exact, p=0.001).

No association with HCV seroprevalence identified:

- **Sharing of risk prone personal HH items was common**, **86.3% reported sharing at least one item** (toothbrush, nail clipping scissors and/or razors). HCV seroprevalence was similar among those who shared at least one item compared to those who shared none (not shown).

- **Only five participants reported IDU** (four females), four in the camps and four in Myanmar, one in Cox's Bazar City. No association was indicated between IDU and HCV seropositivity (not shown).

- **Seven participants reported having experienced sexual violence** (three male, four female, four in the camps and two in Myanmar); No association with HCV seropositivity was indicated.

- **Piercings were frequent (29.6%)**, and HCV seroprevalence was similar among those with or without piercing.

- **Nobody reported having a tattoo.**

Among female participants

- **Most (88.9%) reported having given birth**. **HCV seroprevalence was notably higher among those who reported having given birth in Myanmar (42.2%), or in Myanmar and in the camps (38.4%),** when compared to women who reported birth having giving birth only in the camp (17.3%) (Fisher's exact, p=0.001). No association was found for the reported type of birth support (TBA, traditional healer, hospital).

- **14.8% reported having had an abortion**, 50% of these in the camps, 48.4% in Myanmar, 1,6% in Cox Bazar City. HCV seroprevalence was 29.0% among those with abortion in the camps and 36.7% among those reporting abortion in Myanmar (p=0.322).

Among male participants

- **Almost all (95.4%) male participants reported being circumcised**. HCV seroprevalence was similar between those circumcised by traditional healer or by other services (not shown).

- **50.9% male participants reported having shaved in a barber shop**. HCV seropositivity was 19.1% among those who shaved at a shop, and 26.7% among those who did not report shaving in a shop. Notably, 11.8% (13/110) of men who reported shaving at a barber also reported having observed re-use of an unclean/already used razor (10 participants reporting for Myanmar, and 11 for the camp).

Table 11 Study population characteristics: HCV exposure risks (N=641)

	Total reported N (%)	HCV seropositive %
Sharing risk prone HH items		
o Toothbrush	171 (26.7)	34.5
o Nail-clipping scissors	500 (78.0)	30.2
o Razor	168 (26.2)	30.2
o Sharing of at least one risk-prone item (all combined)	553 (86.3)	30.2
Medical procedures		
o Medical injection(s)	451 (70.4)	32.6
o Dental or gum procedure	36 (5.6)	39.6
o Surgery	21 (3.3)	61.9
o Medical intervention involving sharp item	25 (3.9)	44.0
o Blood transfusion	8 (1.3)	75.0
o Donated blood	1 (0.2)	0
Cosmetic treatments		
o Piercing(s)	190 (29.6)	29.0
o Salon manicure/pedicure	3 (0.5)	29.0
o Tattoo(s)	0	*NA*
Other risk factors (potential sensitive topics)		
o Ever re-used someone else's needle	33 (5.2)	33.3
o Ever shared your needle with someone else	31 (4.8)	29.1
o Experienced sexual violence	7 (1.1)	42.9
o Intravenous drug use	5 (0.8)	40.0

Table 12 Study population characteristics: HCV exposure risks – female (N-425)

	Total reported N (%)	HCV seropositive %
o Ever pregnant	386 (99.8)	34.7
o Ever given birth[#]	378 (88.9)	35.2
- In Myanmar	228/370 (77.6)	40.1
- In the camp	241/370 (65.2)	31.1
- In Cox's Bazar	4/370 (1.1)	50.0
- At the Hospital	122/360 (33.9)	31.2
- At the Pharmacy	8/360 (2.2)	62.5
- Traditional healer	86/360 (23.9)	40.7
- TBA	233/370 (64.7)	33.9
o Ever had an abortion	63 (14.8)	33.3
- In Myanmar	30/63 (47.6)	36.7
- In the camp	32/63 (50.8)	28.2

- In Cox's Bazar	1/63 (1.6)	100
- At the Hospital	6/63 (9.5)	33.3
- At the Pharmacy	7/63 (11.1)	0
- Traditional healer	16/63 (25.4)	25.0
- TBA	34/63 (54.0)	38.2

[#] N=8 missing information on location of where birth was given (Myanmar, Camp, Cox's bazar), N=18 missing information on who assisted birth (TBA< pharmacy, healer, hospital).

Table 13 Study population characteristics: HCV exposure risks – male (N=216)

	Total reported N (%)	**HCV seropositive %**
o Ever shaved beard at the barber's shop[#]	110 (50.9)	19.1
- In the past	15/110 (13.6)	33.3
- Rarely	30/110 (27.3)	20.0
- Regularly	64/110 (58.2)	14.0
- In Myanmar	61/110 (55.4)	19.7
- In the camp	89/110 (80.9)	16.9
- In Cox's bazar	3/110 (2.7)	0
o Circumcised*	206 (95.4)	21.8
- In Myanmar	200/206 (92.6)	21.0
- In the camp	2/206 (3.2)	57.1
- In Cox's bazar	1/206 (0.5)	0
- At the Hospital	10/206 (4.9)	60.0
- At the Pharmacy	19/206 (9.2)	15.8
- Traditional healer	146/206 (70.9)	22.6
- TBA	14/206 (6.8)	7.1

[#] N=1 missing information on how frequently shaved, N=2 missing information on where shaved

*N=1 information missing on circumcision

7.6. Factors associated with HCV exposure

Multivariate logistic regression **was used to identify factors associated with HCV seropositivity**. Variables selected for the regression analysis were based on associations with HCV seropositivity identified by univariate analysis and chi square tests and univariate regression analysis. The following factors were considered to be included in the model:

- Sex
- Age
- Camp
- Injection(s) for medical reasons
- Surgical intervention(s)
- Dental or gum treatment(s)
- Ever re-used someone else's needle
- Blood transfusion

Few (< 6%) had missing values or responded "don't know" or refused to answer questions about having had a surgical procedure, medical injections, blood transfusion, or re-use of needles. These replies were combined into one category for the two-by-two tabulations (see above) and the regression analysis.

Variables with a p-value of ≤0.2 in univariate regression analysis were integrated into a multivariate model, and variables with a posteriori p-value of ≤0.05 retained in the final model. Reported dental or gum treatment was removed from the final model, with a p-value of 0.765 in the multivariate analysis (not shown).

The final model provided the following risk factor estimates (**table 14**):

- The **adjusted odds ratio (aOR) for HCV seropositivity was nearly twice as high for women** when compared to men (aOR=1.7 (95%CI: 1.1-2.7)).

- Similarly, **age groups ≥25 years** had 2-3-fold higher odds of HCV exposure than the younger age group 18-24 years.

- Participants with reported **medical injection(s) had higher odds of HCV exposure** (aOR=1.5 (aOR=0.9-2.4)), as well as those reporting **surgery** (aOR=5.0 (1.5-16.9)), **ever having re-used someone else's needle** (aOR=1.7 (0.7-4.0)), and/or having had a **blood transfusion(s)** (aOR=2.2 (0.3-16.3)).

- Furthermore, adjusted odds of seropositivity were higher for **residents of camps 8W, 12, 13 and 16, 18 and 19** when compared to camp17, and highest for camp 12 (aOR=15.0 (95%CI: 5.3-42.1)).

Sensitivity analysis

A sensitivity analysis was conducted, omitting all participants (N=56) with missing values or a response "don't know" or a refused answers to questions about having had surgery, medical injections, a blood transfusion, or having re-used someone else's needle. In the final model of this analysis dental or gum treatment(s), blood transfusion, and ever re-used someone else's needle were removed due to insignificant posteriori p=values.

The sensitivity analysis identified female sex, age group 25 years and older, having had medical injection(s), and surgery as significantly associated with HCV seropositivity (**table 15**). Camp residence other than camp 17 also remained associated with higher odds of seropositivity.

Notably, 41.1 % of the 56 individuals omitted from sensitivity analysis tested HCV seropositive, versus 28.7% among those retained in the analysis (chi2 p=0.053), also reflected in higher odds observed for the small subgroup with missing/don't know or refused answers, respectively, regarding medical injection(s) and/or having re-used someone else's needle. Also, four of eight participants reporting blood transfusion were among these 56 omitted (all four were HCV seropositive), which explains why the significant association of blood transfusion with HCV seropositivity was no longer retained in the sensitivity model. Similarly, a larger proportion than in the overall survey sample (12.5% of the 56 omitted participants) had reported dental treatment (two of these RDT-positive).

Participants with self-reported chronic diseases (including diabetes):

Participants who self-reported chronic diseases also had higher HCV seropositivity. Among 49 participants reporting diabetes, 49% were HCV seropositive, 55.8% among those who reported "heart disease", 53% among few who reported chronic asthma, 45.5% among few who reported COPD, and 75% among eight who reported chronic liver disease, respectively. Self-reported diabetes had been explored among the above cited risk factors in univariate and multivariate regression analysis, but the association did not remain significant in multivariate analysis (not shown).

Table 14 Univariate and multivariate analysis of factors associated with HCV seropositivity (N=641)

Characteristics	HCV-seropositive Survey adjusted estimate % (95%CI)	Univariate cOR (95% CI)	p-value	Multivariate aOR (95% CI)	p-value
All participants					
Camp			**0.001**		**<0.001**
17	8.5 (0.3-18.3)	1.0		1.0	
8W	25.0 (16.5-35.9)	3.6 (1.3-9.7)		3.7 (1.3-10.7)	
12	45.9 (34.7-57.5)	9.2 (3.5-24.4)		15.0 (5.3-42.1)	
13	28.4 (20.6-37.9)	4.3 (1.7-11.2)		6.8 (2.5-18.8)	
16	32.5 (22.1-45.0)	5.2 (1.9-14.2)		8.9 (3.0-26.1)	
18	29.8 (20.9-40.5)	4.6 (1.7-12.1)		6.7 (2.4-18.6)	
19	33.0 (23.1-44.6)	5.3 (1.9-14.3)		7.7 (2.8-21.6)	
Sex			**0.008**		**0.004**
Male	22.1 (16.8-28.5)	1.0		1.0	
Female	32.8 (28.1-37.9)	1.7 (1.2-2.6)		1.7 (1.1-2.7)	
Age (years)			**0.025**		**0.003**
18-24	13.8 (7.3-24.5)	1.0		1.0	
25-34	29.1 (23.3-35.7)	2.5 (1.2-5.5)		2.6 (1.2-5.5)	
35-44	36.4 (27.8-45.9)	3.6 (1.6-7.9)		3.4 (1.5-7.5)	
45-54	31.9 (22.2-43.5)	2.9 (1.3-6.9)		3.2 (1.3-7.7)	
≥ 55	36.3 (26.0-48.2)	3.5 (1.5-8.3)		3.5 (1.5-8.3)	
Injection(s) for medical reasons			**0.066**		**0.042**
No	23.8 (17.5-31.4)	1.0		1.0	
Yes	31.8 (27.3-36.8)	1.5 (0.9-2.3)		1.5 (0.9-2.4)	
Don't know/missing	58.2 (15.7-91.2)	4.5 (0.9-22.3)		2.6 (0.4-16.2)	
Surgical intervention(s)			**0.053**		**0.009**
No	28.9 (66.9-74.9)	1.0		1.0	
Yes	57.6 (32.2-79.5)	3.3 (1.2-8.9)		5.0 (1.5-16.9)	
Don't know/refused	26.1 (8.0-58.8)	0.9 (0.2-3.1)		0.9 (0.2-3.8)	
Dental or gum treatment(s)			**0.05**		
No	29.6 (25.8-33.8)	1.0			
Yes	31.6 (16.5-51.8)	1.1 (0.5-2.5)			
Blood transfusion			**0.015**		**0.028**
No	29.3 (25.5-33.4)	1.0		1.0	
Yes	76.0 (27.7-96.3)	7.6 (1.5-39.9)		2.2 (0.3-16.3)	

Don't know/refused/missing	0	-		-	
Ever re-used someone else's needle			**0.046**		**0.002**
No	29.1 (25.2-74.8)	1.0		1.0	
Yes	34.5 (18.8-54.6)	1.3 (0.6-3.0)		1.7 (0.7-4.0)	
Don't know/refused/missing	31.4 (11.9-60.8)	2.5 (1.2-5.4)		3.6 (1.4-9.4)	

Table 15 Multivariate analysis of factors associated with HCV seropositivity (sensitivity analysis, omitting responses don't know/refused, or missing information) (N=585)

Characteristics	HCV-seropositive Survey adjusted estimate % (95%CI)	Univariate cOR (95% CI)	p-value	Multivariate aOR (95% CI)	p-value
All participants	28.5 (24.6-32.7)				
Camp			**<0.001**		**<0.001**
17	8.5 (3.4-19.8)	1.0		1.0	
8W	20.7 (12.2-32.8)	2.8 (0.9-8.6)		3.6 (1.2-11.3)	
12	46.5 (35.2-58.1)	9.4 (3.3-26.8)		14.3 (4.9-42.2)	
13	27.3 (19.5-36.6)	4.0 (1.4-11.4)		5.8 (2.0-16.9)	
16	34.0 (23.0-47.0)	5.6 (1.9-16.5)		8.5 (2.7-26.2)	
18	27.5 (18.7-38.4)	4.1 (1.4-11.8)		6.0 (2.0-17.7)	
19	27.8 (18.5-39.7)	4.2 (1.4-12.2)		6.0 (2.0-18.3)	
Sex			**0.005**		**0.003**
Male	20.3 (15.1-26.9)	1.0		1.0	
Female	31.9 (27.0-37.2)	1.8 (1.2-2.8)		1.8 (1.2-2.9)	
Age (years)			**0.147**		**0.011**
18-24	15.1 (8.0-26.6)	1.0		1.0	
25-34	29.0 (23.0-35.9)	2.3 (1.1-5.0)		2.4 (1.1-5.0)	
35-44	32.7 (24.2-42.7)	2.7 (1.2-6.2)		2.9 (1.3-6.5)	
45-54	29.8 (20.1-41.8)	2.4 (1.0-5.7)		2.8 (1.1-6.7)	
≥ 55	33.8 (23.2-46.4)	2.9 (1.2-6.9)		3.2 (1.3-7.8)	
Injection(s) for medical reasons			**0.073**		**0.005**
No	23.0 (16.8-30.7)	1.0		1.0	
Yes	31.1 (26.4-36.3)	1.5 (0.9-2.3)		1.7 (1.0-2.6)	
Surgical intervention(s)			**0.135**		**0.004**
No	28.0 (24.1-32.2)	1.0		1.0	
Yes	46.7 (21.2-74.1)	2.3 (0.8-6.6)		4.7 (1.3-16.7)	
Dental or gum treatment(s)			0.831		
No	28.4 (24.5-32.7)	1.0			

	Yes	30.4 (14.4-53.3)		1.1 (0.4-2.7)		
Blood transfusion					0.607	
	No	28.4 (24.6-32.6)		1.0		
	Yes	40.0 (16.6-96.3)		1.7 (0.2-12.1)		
Ever re-used someone else's needle					0.471	
	No	28.2 (24.2-32.5)		1.0		
	Yes	34.5 (18.8-54.6)		1.3 (0.6-3.0)		

7.7. Factors associated with viremic HCV infection

Factors associated with viremic HCV infection among HCV-seropositive were assessed by univariate and multivariate logistic regression analysis. Variables selected for the multivariate regression analysis were:

- Sex
- Age
- Camp
- Reported treatment for HCV infection

Variables with a p-value of ≤0.2 in univariate regression analysis were integrated into a multivariate model, and variables with a posteriori p-value of ≤0.05 retained in the final model.

The only significant association with viremic status among seropositives in the univariate regression analysis was "**self-reported treatment for HCV infection"** (p=0.003). Sex, age and camp location were not significantly associated but were retained in the final model. After controlling for age, sex and camp, **no self-reported HCV treatment was associated with a nearly 10-times higher odds of viremic infection** among seropositive (aOR= 9.4 (95%CI: 2.2 -40.5)) (**annex, table 12.2**). Sensitivity analysis (omitting N=5 participants with response "don't know") reached similar estimates (**annex, table 12.3**).

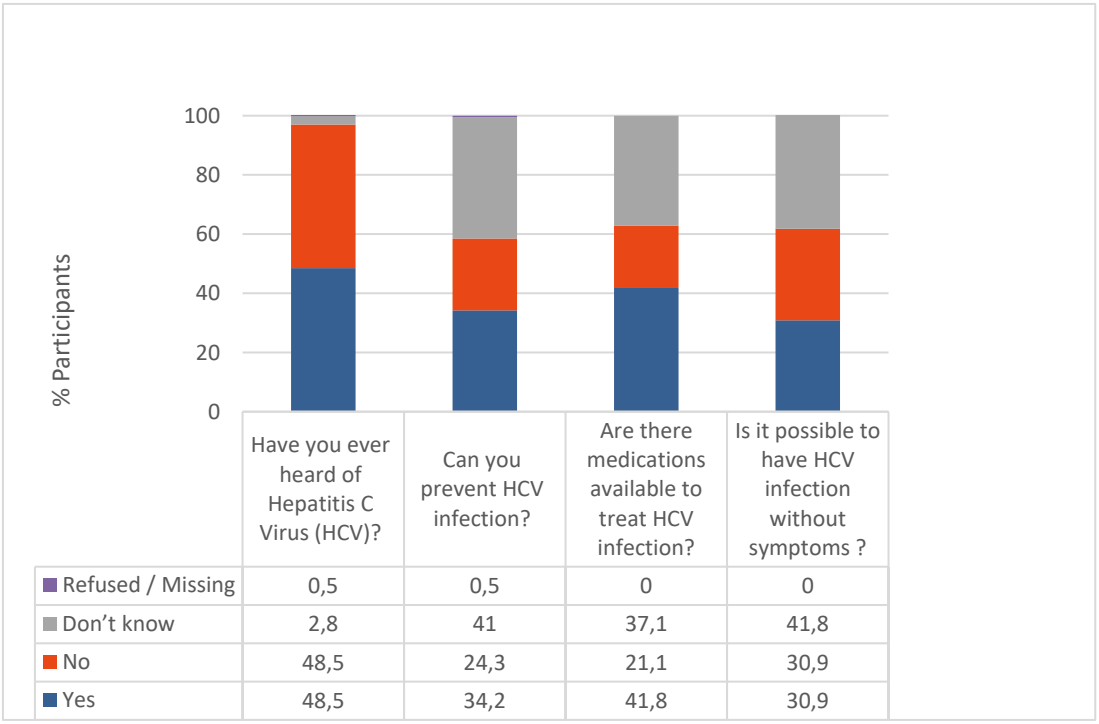
Of note, although not significant in the present analyses, the odds of viremia among seropositive women were somewhat lower compared to men (aOR: 0.7% (95%CI: 0.3-1.5).

7.8. Knowledge about Hepatitis C

During the structured interview, participants were also asked about their knowledge on HCV infection. Less than half (48.5%) indicated having heard about Hepatitis C before, only 34.2% responded that HCV infection can be prevented, 41.8% replied that medications are available to treat HCV infection, and only 30.9% replied HCV infection may be asymptomatic (all questions were probed) (**figure 5**).

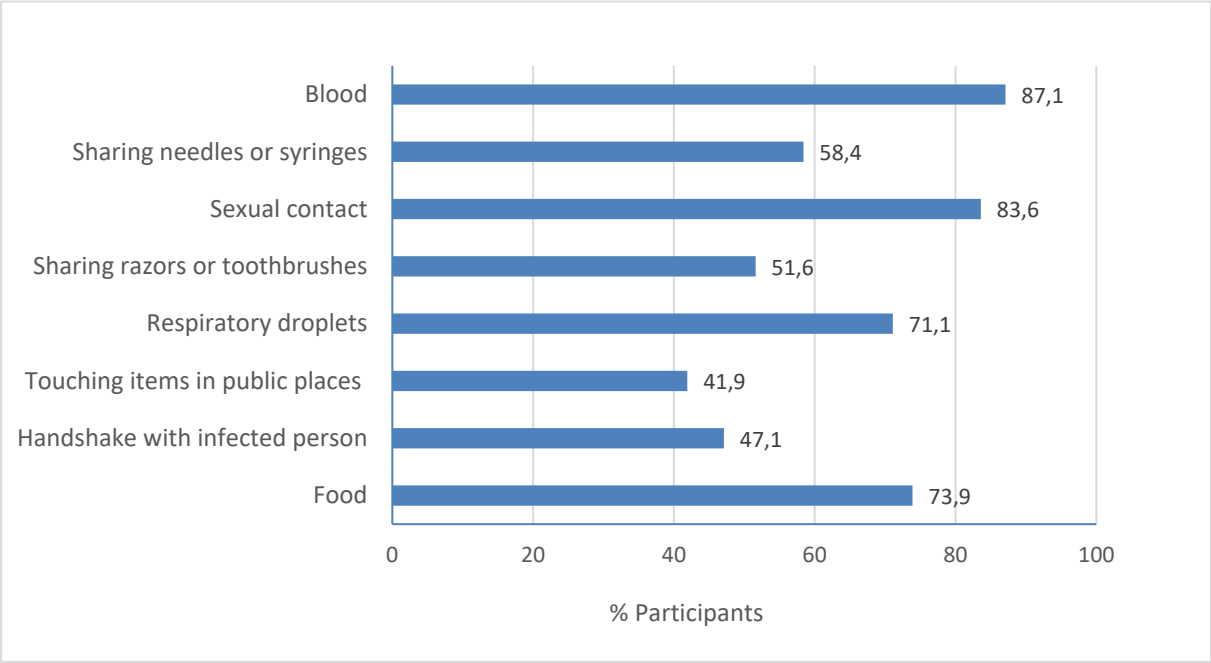
Participants who replied having heard of hepatitis C before (N=310), were also asked:" ***Could you tell me if the hepatitis C virus is transmitted through any of the following***?" and were presented with a list of proposed transmission modes to choose from. Many identified "blood", "sharing needle, syringes, razors and/or toothbrushes", as well as "sexual contact" (**figure 6**). A large proportion also mentioned "food", "respiratory droplets", "hand shaking" and "touching items in public spaces" (**figure 5**). Among those who replied that HCV may be preventable, a list of proposed prevention options was provided to choose from, with replies depicted in **figure 7**. Many chose correct prevention measures, though nearly half (47.0 %) replied that a vaccine is available.

Figure 4 Knowledge about Hepatitis C (N=641)



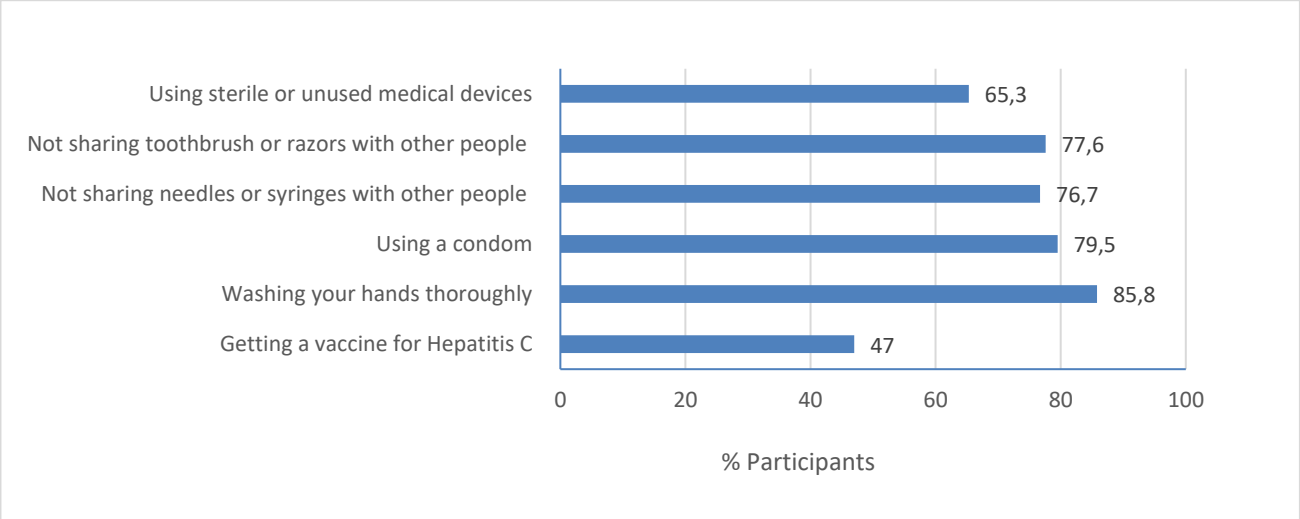
	Have you ever heard of Hepatitis C Virus (HCV)?	Can you prevent HCV infection?	Are there medications available to treat HCV infection?	Is it possible to have HCV infection without symptoms ?
Refused / Missing	0,5	0,5	0	0
Don't know	2,8	41	37,1	41,8
No	48,5	24,3	21,1	30,9
Yes	48,5	34,2	41,8	30,9

Figure 5 How can HCV be transmitted (probed)? (N=310)



Assessed among N=310 who indicated having heard of HCV before.

Figure 6 How can HCV infection be prevented (probed)? (N=219)



Assessed among N=219 who indicated having heard of HCV before and who responded that HCV infection can be prevented

7.9. History of HCV diagnosis and treatment

During the interview, participants were asked about previous HCV diagnosis or treatment (**table 16**):

- **Among 191 HCV seropositive: 38.2% (73/191) were aware of HCV exposure/infection** N=70 of these reported previous HCV diagnosis, N=9 of these also self-reported chronic HCV infection (unprobed), and N=1 reported chronic HCV infection but did but did not indicate previous HCV diagnosis), and **10.5% reported previous HCV treatment**[a] (25.0% of seropositive reporting previous treatment were viremic).

- **Among seropositive, 10.5% (20/191) reported previous treatment** (N=5 currently HCV viremic), **all 20 had reported previous HCV diagnosis; correspondingly 27.4% (20/73) among those previously diagnosed reported having received HCV treatment before.**

- Among HCV viremic participants, 33.1% (41/124) reported previous HCV diagnosis, and 4.0% (5/124) reported previous HCV treatment, 12.2% (5/41) among those viremic and reporting previous HCV diagnosis, respectively.

- N=4 participants reported **currently receiving HCV-treatment**, but only one was HCV seropositive, suggesting misunderstanding of HCV infection and treatment. Similarly, some HCV seronegative reported having been diagnosed with HCV before or having received HCV treatment (table 11).

Table 16 Reported history of HCV diagnosis and treatment

N (%)	Total Participants 641	HCV Sero-positive 191
Have you ever been diagnosed with HCV infection?		
Yes	**84 (13.1)**	**70 (36.7)***
No	528 (82.4)	111 (58.1)
Don't know	23 (3.6)	8 (4.2)
Refused	2 (0.3)	-
Missing information	4 (0.6)	2 (1.1)
Have you ever taken medication to treat Hepatitis C infection?		
Yes	**33 (5.2)**	**20 (10.5)**
No	597 (93.1)	166 (86.9)
Don't know	7 (1.1)	5 (2.6)
Refused	2 (0.3)	-
Missing information	2 (0.3)	-

[a] Among N=20 HCV seropositive participants who reported previous HCV treatment: N=2 had treatment in 2023 (one of these indicated treatment start on the date of survey, suggesting misunderstanding or recording error); N=11 reported HCV treatment in 2022, one in 2020, and one in 2010 (the latter also suggesting misunderstanding).

N=10 among HCV seropositive self-reported chronic HCV infection (un-probed); N=1 of these did not answer having been diagnosed with HCV before. Taken together: N=71 (70+1) of HCV seropositive are considered as being aware of HCV exposure.

8. DISCUSSION

Limited data suggested an unusually high Hepatitis C (HCV) seropositivity (antibody positive) among Rohingya or Forcibly Displaced Myanmar National (FDMN) people residing in densely crowded camps in Cox's Bazar district, Bangladesh [3][4][5]. The MSF OCP HCV treatment program, which started in October 2020, also showed a high proportion of HCV seropositive and actively infected among patients screened in IPD and OPD facilities in the camps, further underlining that HCV infection is a public health issue in the camps. Information on the prevalence of active HCV infection and factors associated with HCV exposure in the general camp population was lacking.

The present survey aimed to provide updated and representative prevalence estimates of HCV exposure and active HCV infection in the camps. In addition, to identify factors associated with HCV infection, and to gain insights into awareness and knowledge about HCV in the camp population. The findings were expected to inform on the target population and estimated number of people who may require diagnosis and treatment, to inform interventions for prevention and diagnosis, and to generate robust data promoting the scale up of HCV diagnosis and care for the entire Cox's Bazar camp community.

High HCV seroprevalence in the Cox's Bazar camps.

Between May and June 2023, we conducted a survey in seven camps of the MSF OCP catchment area (camp 8W, 12, 13, 16, 17, 18 and 19) using simple random geospatial sampling methods, including 641 adults from 641 randomly selected households. HCV seropositivity was assessed with a rapid HCV antibody test among all participants, leading to a survey-adjusted estimate of HCV seroprevalence for adult FDMNs of 29.7% (95% CI: 26.0-33.8), indicating that about one in three adults was exposed to HCV infection. Notably, seroprevalence was significantly higher among women (32.8% (28.1-37.9)) then among men (22.1% (16.8-28.5)) (p=0.007, chi2), and lower in the youngest age group (18-34 years) (13.8% (7.3-24.5)).

These estimates even exceeded alarming earlier reports. In 2017, the National Liver Foundation of Bangladesh (NLFB) conducted an assessment for Hepatitis B and C prevalence among 300 conveniently selected pregnant women from ANC services in the camps, and reported 8% HCV seropositivity [5]. In 2018 an outbreak investigation of Acute Jaundice Syndrome (AJS) in the camps identified 56% seropositive for Hepatitis A (presumed main etiology of the outbreak) but also 9% HCV seropositive among 275 health facility-derived samples (mainly adults) [4]. A larger community survey conducted by the NLFB in three camp blocks in 2019 included 2000 participants aged ≥7 years and reported 22% HCV seroprevalence among adults, and notably also higher seroprevalence among women than men (26% versus 18%) [5]. Furthermore, since October 2020, MSF OCP provides a simplified Hepatitis C testing and treatment delivery model, providing treatment free of charge for the population residing in Cox's Bazar camps, with screening and testing mainly adults presenting with chronic diseases in MSF-supported outpatient and inpatient facilities in the camps. Notably, among 12 127 OPD and IPD patients screened between October 2020 and March 2023, overall HCV seropositivity was also high (54%), with a viremic rate of 70% among seropositive (MSF programme data).

High prevalence of active HCV infection

Importantly, no representative estimate of active HCV infection in the camps was available. A small pilot survey in 2019 conducted in one small camp (Lambasia) with a less than 300 residents by the Department of Hepatology, Medical University, Dhaka, reported a worrying 13.2% HCV RNA positivity among 53 blood samples tested [3].

The present survey screened for active HCV infection following the WHO recommended "reflex-testing", assessing for HCV viral load (active infection) among survey participants who tested HCV seropositive [6] leading to a strikingly high survey-adjusted estimate of active HCV infection of 19.6% (CI95%: 16.4-23.2). Prevalence estimates were high across all adult age groups, and high among women (21.1% (17.1-25.7), and men 15.8% (11.4-21.6), corresponding to a high prevalence generalized HCV epidemic. These astonishingly high estimates suggest that about one in five adults in the camps is living with active HCV infection, which surpasses by ten to twenty-fold the latest available prevalence estimates for the general population in Bangladesh and Myanmar were HCV is considered endemic. The 2019 national population estimate of chronic HCV infection in Bangladesh is 0.55 % (0.45 - 0.67) and 1.88 % (1.53 - 2.30) in Myanmar [16].

High viremic rate indicating gaps in HCV treatment

In the absence of treatment, about one-third of people with HCV infection are thought to clear infection spontaneously [17]. The high survey-adjusted viremic rate of 66.6 % (58.9-73.6) (active infections among HCV seropositive) implies that the population remains largely untreated. Similarly, MSF HCV program data showed a very high viremic ratio among seropositive OPD and IPD patients (70.3% average viremic rate, MSF laboratory data up to Oct 2023). Furthermore, only 10.5% of seropositive survey participants reported previous HCV treatment, which together with the high viremic ratio, indicates a significant gap in HCV treatment in the camps. A cross-sectional survey conducted by MSF in 2022 in large slum settlements in the Karachi, Pakistan, also reported a considerable high HCV seroprevalence (13.4% (11.1-15.8), with 4.1% (95%CI 3.1-5.4) active HCV infection overall [18]. In contrast to our findings, the viremic ratio in Karachi settlements in Pakistan was about half (32% (95%CI: 24.3-40.5)), and 44% of seropositive reporting previous HCV treatment, which was interpreted as a consequence of nearly 10 years of free of cost access to diagnosis and treatment for the population.

Factors associated with HCV exposure

Known high transmission risks of the bloodborne Hepatitis C virus are exposure to unsafe medical procedures (iatrogenic transmission), including unscreened blood transfusions, procedures involving re-use of contaminated needles or sharp instruments for medical injections, surgical interventions, obstetric- or gynecological procedures, dental treatments, as well as injection drug use involving needle sharing; furthermore, personal care and cosmetic treatments with non-sterilized equipment (tattoos, piercings, salon nail-care or shaving at barber shops), sharing of personal items like razors or toothbrushes, sexual transmission (mainly men having sex with men (MSM), or sexual violence) ([1]; [19]). The estimated risk of vertical HCV transmission is around 7% [20]. The present survey assessed exposure to high risk factors through a structured interview.

Multivariate regression analysis identified higher odds of HCV seropositivity for women than men (adjusted odds ratio (aOR)=1.8 (95%CI: 1.2-2.9), and age older than 24 years (aORs ranging between 2.3-2.9), respectively.

Higher risk of HCV seropositivity with increasing age is well established, with HCV antibody positivity remaining for life. Recent surveys conducted by MSF in Cambodia, and in slum settlements in Karachi, Pakistan, also reported a clear increase in HCV seroprevalence with age ([21], [18]. As for representations of HCV exposure in the general male versus female population, trends may differ per setting. In the Battambang Province, Cambodia, the survey-adjusted overall HCV seroprevalence estimate was 2.6% (2.3-3.0), with a significantly higher prevalence among men (3.0% (2.5-3.5) then in women 2.3% (1.9-2.7), while the survey in the Karachi settlements in Pakistan did not identify a significant difference in prevalence between male and female [18]. A study that assessed HCV seroprevalence in the general female population of 9 countries in Europe, Asia and Africa between 2004 and 2009 indicated widely differing female HCV seroprevalence between countries, and reported an association with increasing age and medical interventions/hospitalizations linked to childbirth, while no association with sexual intercourse was found [22].

Further, we identified a strong association (nearly 5-fold increased odds) with HCV seropositivity, for reported history of a surgery (aOR=4.7 (95%CI: 1.3-16.7), and nearly two times higher odds of seropositivity for reported medical injection(s) (aOR=1.7 (95% CI: 1.0-2.6). The recent HCV prevalence survey conducted by MSF in the slum settlements in Karachi, Pakistan, also reported increased odds of HCV seropositivity with each additional reported therapeutic injection in the past 12 months (OR =1.07 (95%1.00-1.13)), in a context where medical injections are considered a particularly common health care demand [18]. The present survey did not assess the number of received medical injections, but more than two-third of participants (70.4%) had reported medical injection(s), almost all in the camp, and two thirds also in Myanmar. Almost all of these (90.8%) injections were reported at a hospital, 66.9% at traditional healers, 22.6% at the pharmacy, and/or or through TBAs (8.5%). We did not identify differences in HCV seropositivity by location or source of injections. Surgery was reported only by few participants (3.3%), 35% of these in the camp, 40% in Cox's Bazar City, 35% in Myanmar (no indication for differences in HCV seropositivity by surgery location).

Overall, 5.2% reported having re-used someone else's needle, few (1.3%) reported having had a blood transfusion, and only 0.8% reported intravenous drug use. Both needle sharing and IDU are sensitive topics and may have been underreported, while re-used needles in the context of medical injections may also not be recognizable for people. Multivariate analysis identified increased odds of HCV seropositivity associated with reported blood transfusion, dental treatments, or re-use of needles in the main multivariate model. These associations did not remain significant in a sensitivity analysis which omitted 56 participants (< 6%) who had either missing responses or responded “don’t know” or had refused the answer. Statistical power in our survey was limited when assessing associations of infrequently reported risk factors. The survey in Pakistan also identified history of blood transfusion associated with HCV exposure (OR = 1.72 (0.90-3.21)). The prevalence survey conducted in Battambang Province, Cambodia, also identified routine medical care procedures, injections, blood donation or transfusions significantly associated with seropositivity among adults ≥ 45-year age group [19].

Shaving at barber shops was also assessed, and about half of men reported having shaved their beard in a barber shop before, 80.9% in the camps, and 58.2% regularly. Seroprevalence estimates did not differ between those reporting shaving at barber shops or not. Notably however, 11.8% of men who reported shaving at barber shops (in the camps and/or in Myanmar), the reuse of unclean/already used. Sharing of personal items with transmission potential (toothbrush, nail clipping scissors and/or razors) was very commonly reported (86.3% at least one item), nearly half had received salon nail-care before and nearly one-third had reported piercings (no reported tattoos), and 14.8% of women reported abortion. No evidence was found for an association of these potential factors with HCV seroprevalence. Since almost all female participants had given birth before (cesarian section was not investigated), and almost all men reported being circumcised, this did not allow to identify obstetric care or circumcision as HCV exposure risk.

The present survey did not aim at and was not powered to assess potential differences in HCV prevalence by camp, but prevalence estimates varied somewhat between surveyed camps. Confidence intervals of camp-specific estimates were wide and did not allow to establish significant differences, except for significantly lower seroprevalence in camp 17, confirmed also in the multivariate regression analysis. Reasons underlying potential prevalence heterogeneity are unknown, but the relative extend of HCV exposure was uniformly high.

Awareness and knowledge about Hepatitis C

Knowledge in the FDMN population on Hepatitis C was incomplete and correct statements (such as blood identified among main transmission risk) may have been overestimated due to probed survey questions. Less than half (48.5%) of survey participants had heard about Hepatitis C before, and among these only 41.8% reported that HCV treatment is available, 44.7% of these incorrectly replied that a vaccine is available among prevention measures, and 73.9% indicated food as a potential transmission risk, suggesting confusion with Hepatitis A (common in the camps) and Hepatitis B.
The contextual narrative (not assessed in the survey) is that people who know about Hepatis C may have difficulties understanding the differences between seropositive versus active infection (viremia), and many may not be able to distinguish different causative agents of jaundice, in a setting where Hepatitis A is also very common and for which symptomatic treatment and health information is provided. Inconsistencies between HCV serostatus and self-reported previous HCV diagnosis or HCV medication also suggested some confusion and misunderstanding in the population. To ensure that participants may properly distinguish Hepatitis C from other acute jaundice-causing infections, surveyors used the term "*POK*" or "*CPOK*" (where C for Hepatitis C and "Pok" stands for "virus") as well as "*hala jondhis*" (referring to "C jaundice"), corresponding to the term used for hepatitis C in the local language.

Addressing the gaps

The survey findings do not allow to estimate when and where HCV exposure occurred, nor provide information on the level of ongoing transmissions in the camps since acute and chronic HCV infection cannot be differentiated and no information is available on HCV exposure status of the population before arriving in the camps. It has been discussed and reported before that the Rohingya people faced poor living conditions and denial of access to basic health care in Myanmar [9], but no historical data

are available on HCV prevalence for the Rohingya population in Myanmar. Earlier assessments in the camps in 2017, 2018 and 2019, respectively, even if not fully representative, suggest that HCV prevalence was already considerably high shortly after the majority of Rohingya had arrived in the camps (arrivals mainly in 2017), and likely has since gradually increased [3][4][5]. The extremely high and generalized HCV prevalence suggests that HCV transmission likely continues at high rates in the camps to date, also involving relatively lower risk exposure such as sexual and parenteral transmission, while transmission through unsafe medical- or recreational/cosmetic procedures is also indicated.

Extrapolation of the survey estimates to the general adult population ((464'324 adults, UNHCR/Bangladesh government camp population statistics, September 2023), suggests that overall, approximately 86 000 adults may currently require HCV treatment in the camps (estimation adjusted for slightly higher proportion of women included in the survey, and assuming camps are equal). This underlines the urgent need for other actors in the camps to step in and support scale up of access to diagnosis and treatment, and integration of HCV care into the general health care package for the entire Cox's Bazar camp community. Health education campaigns should address the significant gaps in awareness and knowledge about Hepatitis C in the population at risk and reinforce HCV prevention and safe medical practices in all health care providing sectors in the camps. Egypt's viral hepatitis plan of action 2014-2018 for example included education campaigns for communities focusing the communication on 5 key messages distributed through social media and TV, as well as a national training and auditing campaign with health care providers and facilities to support adherence to infection control policies to prevent hospital acquired infections [23].

A main challenge will be to effectively identify those undiagnosed and untreated and ensure fast linkage to care with current gaps in HCV diagnosis and treatment in the camps. MSF OCP started providing Hep C screening, diagnosis, and treatment in the Cox's Bazar camps in October 2020 with a simplified public health approach that comprises few mandatory lab tests and clinical based decision for decompensated cirrhosis. Screening and treatment criteria are patients age>40 years, with comorbidities seen in the non-communicable disease cohort, or patients with signs or symptoms of decompensated cirrhosis, as well as patients admitted to the medical ward or in the mental health cohort. Between October 2020 and October 2023 MSF enrolled 4483 patients on HCV treatment, 4243 completed 12/24 weeks treatment with a cure rate of 94% (MSF OCP programme data 2023). The capacity of OCP treatment program has a maximum quota of 150 new patients needing treatment per month. MSF operational center Brussels (OCB) -provides HCV testing and treatment free of charge since October 2020, mainly in camps 14 and 15, and with overall lower capacity of 100 treatments per month.

Updated 2022 WHO HCV guidelines are now recommending a shift to delivering testing and treatment integrated into primary care to expand access to diagnosis and treatment [24]. In settings with high HCV antibody seroprevalence in the general population (defined as >5%), the recommendation is that all adults have access to and be offered HCV testing with linkage to prevention, care and treatment services [24]. Targeted screening of high-risk group patients should also be expanded, considering high seropositivity and viremic rates observed among patients screened in the MSF OCP HCV programme. A trend for higher seropositivity was also seen among survey participants who self-reported chronic diseases in the survey interview, notably those reporting diabetes (49.0% seropositive), "heart

disease" (55.8% seropositive), chronic asthma (52.9%), and among few reporting COPD (45.5%) or chronic liver, disease (75.0%), respectively.

Pan-genotypic direct-acting antivirals (DAAs) (mostly sofosbuvir and daclatasvir) have changed the landscape of HCV response, with high cure rates (>95%) and short treatment duration (12 to 24 weeks, depending on the absence or presence of cirrhosis). Not only is early treatment important to prevent liver damage, it is also critical to prevent further transmission of the infection. Since 2018, WHO recommendation is to treat all adults with DAA [6]. Scaling up of the MSF simplified model of care should facilitate the uptake of HCV treatment provision by other actors in the camps. National Hepatitis C treatment and clinical guidelines are currently under development, also considering elements of the MSF simplified model of care implemented in the camps. In many low- and middle-income countries the DAA treatment course is now available for less than $50 per treatment course. In Bangladesh, locally produced DAAs are notably higher in price, a bottle neck that will need to be addressed. In May 2016, the World Health Assembly endorsed the Global Health Sector Strategy to eliminate viral hepatitis (Hepatitis B and HCV infection) as a public health threat by 2030, which included also Bangladesh [7]. The 2019 action plan of the WHO South East Asia Region (SEAR) set among their targets for elimination of viral hepatitis 90% of people living with chronic HCV-infection diagnosed and 80% treated by 2030 [25]. Central to achieving the elimination targets are expanded screening, diagnosis, linkage to care and universal access to affordable pan genotypic direct-acting antiviral therapy [26], [27].

Pediatric HCV infection

The present survey did not include children. The burden of active HCV infection among the <18years and younger children in the camp is thus unknown. Among 1100 children that were assessed in the survey conducted by NLFB in 2019, 1% of children and adolescents age ≥ 7 years had been exposed to HCV infection [5], without information on active HCV- infection. Globally an estimated 3.2 million children and adolescents are living with chronic hepatitis C infection [1]. The risk of maternal transmission is estimated to occur in 3-10 % of the cases. While perinatal infection is often silent, it risks chronic liver disease and liver cancer in early adulthood [19]. With the alarmingly high rate of active HCV infection also among adult women of reproductive age in the present survey (estimated one in five with active HCV infection), routine screening before pregnancy and during antenatal services should be considered, as well as systematic testing of children of HCV exposed mothers. Since 2022, WHO recommends that countries include testing and treatment of children and adolescents into national treatment guidelines [8]. Furthermore, the “treat all” with effective DAAs recommendation for adults was extended to include children (age ≥3 years) and adolescents, acknowledging the lack of generic pediatric DAA formulations that will be required for about one-third, younger HCV-infected children [8].

Strength and limitations of the survey

The survey methodology using random geospatial sampling with inclusion of a sufficiently large sample allowed for provision of robust estimates of HCV exposure, and for the first time also an estimate of active HCV infection in the general adult FDMN population residing in the Cox’s Bazar camps. The

survey could also provide some indication on factors associated with HCV exposure, which will guide prevention and intervention measures.

It must be considered that the survey could not exclude potential bias towards assessing people being at home during daytime hours and weekdays when the survey took place. For feasibility reasons, the adult participant in each HH was chosen randomly among those HH members who were either present at the time of the survey or reportedly returning to the HH within the next three days. Demographic statistics of participants confirm a degree of selection bias, with two-thirds of participants being female (66.3%), while UNHCR camp statistics report 46% female among adults living in the seven surveyed camps [15]. Notably, almost all participants (98%) reported not having been away from the camp (= spent night(s) outside the camp) in the past 12 months, while it is known that people (mainly male camp residents) may seek work in outside camp (Ukhiya or Coxsbazar), which may involve periodical absence from the camp. The survey was conducted in seven of eight camps that comprise the catchment area of MSF OCP. The vast majority (80.6%) of people arrived in Cox's Bazar in 2017, and overall, the population residing in the camps is believed to be relatively homogeneous in terms of demographics and access to health care. The findings of the survey on HCV prevalence and risk factors of infection were thus expected to be largely representative of the entity of the Cox's Bazar camps. Data from the MSF HCV treatment cohort (Oct2020-Oct2022, OCP program database) indicate that people identified with active HCV infection and enrolled for treatment originated from all the Cox's Bazar camps, although a high proportion (47% total) indeed resided in one of the eight OCP-supported camps. In addition, MSF OCB provides HCV testing and treatment free of charge since October 2020 in camps 14 and 15. Exact extrapolation of the prevalence estimates to all 20 camps in Cox's Bazar therefore needs to be done with respective caution. However, if sampling from the seven OCP-supported camps carries a potential bias, it would more likely lead to an underestimation of the overall burden of HCV infection in all camps.

Conclusions

The survey yielded robust estimates of HCV exposure and, for the first time, provided a representative estimate of active HCV infection among the FDMN population in Cox's Bazar camps. It suggests that approximately one in three adults have been exposed to HCV infection, and about one in five adults currently live with active HCV infection in the camps. These findings point to a generalized HCV epidemic, with a high burden of active HCV infection affecting both men and women of all age groups, albeit to varying degrees.

Extrapolating the survey findings to the entire camp population indicates that around 85,000 adults may currently be undiagnosed and untreated, emphasizing the urgent need for other actors to intervene and support the expansion of access to HCV diagnosis and treatment. Linkage to care and early treatment will be crucial to reducing the incidence of severe liver disease and preventing further transmission in this high-prevalence setting. Notably, HCV diagnosis and care are currently not integrated into the comprehensive healthcare package for refugee/displaced people in camps. Médecins sans Frontières is currently the sole entity providing HCV testing and treatment (free of cost) in the Cox's Bazar camps. Health education campaigns should address significant gaps in awareness and knowledge about Hepatitis C in the population, and infection and prevention control initiatives should reinforce safe medical practices across all healthcare sectors in the camps.

9. RECOMMENDATIONS

Facing the generalized HCV epidemic and high prevalence of active HCV infection affecting the FDMN population in the Cox's Bazar camps, a multi-partner Task Force initiative and the development of a strategic plan to effectively diagnose and treat HCV infection in the camps (to avert disease and prevent further HCV transmission) is strongly recommended. Proposed elements include:

- The survey findings advocate for the need to integrate HCV prevention, diagnosis, and care into the general health care package for the entire Cox's Bazar camp community.

- Health-facility based screening should be combined with community-outreach screening of the general adult population. WHO recommended reflex testing with antibody-screening by rapid diagnostic tests may be done under task shifting principles, followed by HCV RNA testing with near-point of care NAAT assay platforms in the camps, which may be further expanded by centralized laboratory RNA testing if required (with optional use of dried blood spot samples to facilitate sample collection and transport).

- Adoption of the simplified model of care implemented by MSF OCP since 2020 in the camps should facilitate uptake of DAA treatment provision by other health actors and ease the treatment scale up in the camps.

- Advocacy initiatives should address wide-scale access to more affordable DAA treatments in Bangladesh.

- Education and promotion of prevention and infection control measures for all health care providing sectors in the camps, including traditional healers and traditional birth attendants, is strongly recommended.

- Health education campaigns should address the significant gaps in information about HCV prevention, diagnosis, and treatment for the general camp population, including also key community stakeholders in the camps, as well as relevant service providers for personal care or cosmetic treatments.

- Community engagement to support linkage to care and address stigma and discrimination is recommended.

- Implementation of a monitoring strategy to follow up on testing and treatment coverage, treatment outcomes and the evolution of HCV active infection rates among screened population.

Recommendations that specifically address the high prevalence among women:

- Integration of HCV (ideally in combination with Hepatitis B) prevention information, counseling and testing into adolescent (girls) education programs, family planning and ANC services.

- Testing of children born to HCV seropositive women and integration of pediatric DAA into treatment programs, following latest WHO recommendations (treatment recommended from ≥3 years of age, strongly recommend from 6 years of age).

- Assessing the prevalence of HCV exposure and infection among children and adolescents may further guide these recommendations.

- Implementation of viral hepatitis (with special focus on HCV) surveillance to understand and measure the disease burden of Hepatitis C.

- It is highly probable that the camp population also faces a high burden of HBV infection, as indicated by previous studies in the camps [5], advocating for a combination of screening and prevention measures for HCV and HBV, especially in ANC and Maternity to prevent mother to child transmission.

10. BIBLIOGRAPHY

1. World Health Organization (WHO). Hepatitis C FACT SHEET. 2023.
2. World Health Organization (WHO). Global progress report on HIV, viral hepatitis and sexually transmitted infections, 2021. Vol. 53, Who. 2021. 1689–1699 p.
3. Mohsena M, Fazle Akbar SM, Takahashi K, Mohammad Adnan AB, Hosna AA, Uddin MH, et al. Alarming Levels of Hepatitis C Virus Prevalence among Rohingya Refugees in Bangladesh: Emergency National and International Actions Warranted. Euroasian Journal of Hepato-Gastroenterology. 2019;9(1):55–6.
4. Mazhar MKA, Finger F, Evers ES, Kuehne A, Ivey M, Yesurajan F, et al. An outbreak of acute jaundice syndrome (AJS) among the Rohingya refugees in Cox's Bazar, Bangladesh: Findings from enhanced epidemiological surveillance. PLoS ONE. 2021;16(4 April):1–14.
5. Ali M, Rahman MA, Njuguna H, Rahman S, Hossain R, Sayeed A, et al. High Prevalence of Hepatitis B and C Virus Infections Among Rohingya Refugees in Bangladesh: A Growing Concern for the Refugees and the Host Communities. Clinical Liver Disease. 2022;19(1):1–6.
6. WHO. Guidelines for the care and treatment of persons diagnosed with chronic hepatitis C virus infection. Who. 2018. 15 p.
7. WHO. WHO_GLOBAL HEALTH SECTOR STRATEGY ON VIRAL HEPATITIS 2016-2021_TOWARDS ENDING VIRAL HEPATITIS. 2016.
8. WHO. Updated recommendations on simplified service delivery and diagnostics for hepatitis c infection. 2022.
9. Mahmood SS, Wroe E, Fuller A, Leaning J. The Rohingya people of Myanmar: health, human rights, and identity. The Lancet. 2017;389(10081):1841–50.
10. Abhishek Bhatia , Ayesha Mahmud, Arlan Fuller, Rebecca Shin, Azad Rahman, Tanvir Shatil, Mahmuda Sultana, K A M Morshed , Jennifer Leaning SB. The Rohingya in Cox ' s Bazar : When the Stateless Seek Refuge. Health and Human Rights Journal. 2018;20(2).
11. UNHCR G of B. Joint Government of Bangladesh - UNHCR Population Factsheet as of September 2023. 2022.
12. OCHA services. Bangladesh - Outline of camps of Rohingya refugees in Cox's Bazar [Internet]. Available from: https://data.humdata.org/dataset/1a67eb3b-57d8-4062-b562-049ad62a85fd?fbclid=IwAR0N_GqOqP7FwcoGMUEiZu4Sj5uOPRrD86cPHOmqfy9O3oGzCCoCki9ItY
13. UNHCR. GoB UNHCR Population Map as of 31st May 2022. 2022.
14. KoBoCollect software [Internet]. Available from: https://play.google.com/store/apps/details?id=org.koboc.collect.android

15. Government of Bangladesh - UNHCR. Rohingya Refugee Response/Bangladesh: Joint Government of Bangladesh - UNHCR Population Factsheet. 2023.
16. Coalition for Global Hepatitis Elmination. Country Dashboards, Coalition for Global Hepatitis Elimination Hepatitis Elimination. 2019.
17. Ayoub HH, Chemaitelly H, Omori R, Abu-Raddad LJ. Hepatitis C virus infection spontaneous clearance: Has it been underestimated? International Journal of Infectious Diseases. 2018;75:60–6.
18. Mansoor M, de Glanville WA, Alam R, Aslam K, Ahmed M, Isaakidis P, et al. Prevalence and risk factors for hepatitis C virus infection in an informal settlement in Karachi, Pakistan. PLOS Global Public Health. 2023;3(9):e0002076.
19. El-Shabrawi MHF, Kamal NM, Mogahed EA, Elhusseini MA, Aljabri MF. Perinatal transmission of hepatitis C virus: An update. Archives of Medical Science. 2020;16(6):1360–9.
20. Ades AE, Gordon F, Scott K, Collins IJ, Claire T, Pembrey L, et al. Overall Vertical Transmission of Hepatitis C Virus, Transmission Net of Clearance, and Timing of Transmission. Clinical Infectious Diseases. 2023;76(5):905–12.
21. Lynch E, Falq G, Sun C, Bunchhoeung PDT, Huerga H, Loarec A, et al. Hepatitis C viraemic and seroprevalence and risk factors for positivity in Northwest Cambodia: a household cross-sectional serosurvey. BMC Infectious Diseases. 2021;21(1):1–9.
22. Clifford GM, Waterboer T, Dondog B, Qiao YL, Kordzaia D, Hammouda D, et al. Hepatitis C virus seroprevalence in the general female population of 9 countries in Europe, Asia and Africa. Infectious Agents and Cancer. 2017;12(1):1–8.
23. Hassanin A, Kamel S, Waked I, Fort M. Egypt's ambitious strategy to eliminate hepatitis C virus: A case study. Global Health Science and Practice. 2021;9(1):187–200.
24. WHO. Hepatitis C: Key Facts [Internet]. 2022. Available from: https://www.who.int/news-room/fact-sheets/detail/hepatitis-c
25. WHO-SEARS. Workshop on development of costed action plans for viral hepatitis in the South-East Asia Region. 2019.
26. Roudot-Thoraval F. Epidemiology of hepatitis C virus infection. Clinics and Research in Hepatology and Gastroenterology. 2021;45(3):2015–20.
27. C Wendy Spearman, Geoffrey M Dusheiko, Margaret Hellard MS, Hepatitis. Hepatitis C [Hepatitis C]. The Lancet. 2019;394(10207):451–1466.

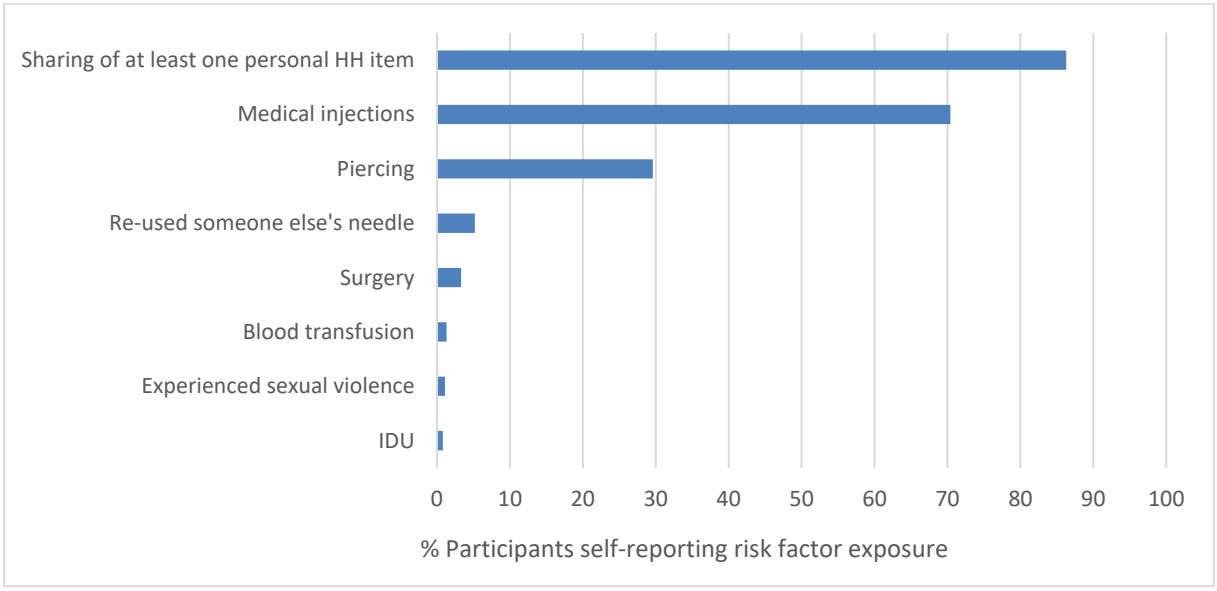
11. ACKNOWLEDGEMENTS

Many thanks to all participants, the surveyors, and MSF teams in Cox's Bazar and Ukhia, Bangladesh for the support and collaboration, including medical coordination, project coordination, laboratory team, logistics, human resources, finance, and MSF patient education team.

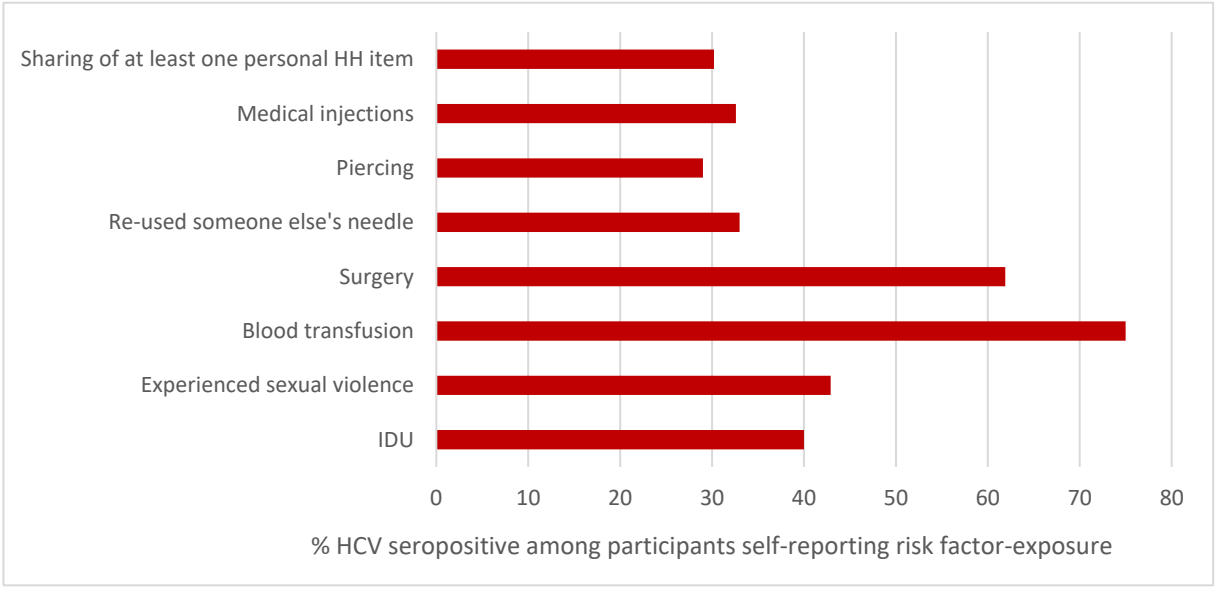
12. ANNEXES

12.1. Reported exposure to HCV transmission rsik factors (A), and % HCV seropositive among those reporting risk exposure (B)

A



B



12.2. Multivariate regression analysis of factors associated with HCV VIREMIA (N=187)

Characteristics	HCV-viremic rate Survey adjusted estimate % (95%CI)	Univariate cOR (95% CI)	p-value	Multivariate aOR (95% CI)	p-value
All participants	66.6 (58.9-73.6)				
Camp			0.872		0.667
12	60.2 (42.8-75.3)	1.0		1.0	
8W	68.6 (44.0-85.9)	1.4 (0.4-4.7)		2.4 (0.6-9.4)	
13	75.3 (54.9-88.4)	2.0 (0.7-6.1)		2.1 (0.7-6.6)	
16	65.4 (41.3-83.6)	1.3 (0.4-6.1)		1.3 (0.4-4.9)	
17	82.4 (17.5-99.0)	3.1 (0.3-30.0)		6.9 (1.2-40.4)	
18	67.6 (45.6-83.9)	1.4 (0.5-4.1)		1.4 (0.5-4.0)	
19	61.4 (40.5-78.8)	1.1 (0.4-3.0)		1.2 (0.3-3.9)	
Sex			0.354		0.360
Male	72.8 (57.0-84.4)	1.0		1.0	
Female	65.0 (55.8-73.1)	0.7 (0.3-1.5)		0.7 (0.3-1.6)	
Age (years)			0.302		0.243
18-24	77.8 (30.0-96.6)	3.0 (0.4-20.9)		2.7 (0.3-21.2)	
25-34	73.5 (60.7-83.2)	2.4 (0.9-6.6)		2.3 (0.7-7.7)	
35-44	58.2 (42.0-72.8)	1.2 (0.4-3.4)		1.2 (0.4-4.1)	
45-54	53.3 (32.7-72.9)	1.0		1.0	
≥ 55	71.2 (50.1-85.9)	2.2 (0.7-7.0)		3.2 (0.8-12.7)	
Having received treatment for HCV infection			**0.003**		**<0.001**
Yes	22. 8 (7.6-51.3	1.0		1.0	
No	71.7 (63.4-78.7)	8.6 (2.5-29.4)		9.4 (2.2 -40.5)	
Don’t know	68.8 (10.1-97.7)	7.5 (0.8-69.6)		5.9 (0.6-64.5)	

12.3. Multivariate regression analysis of factors associated with HCV VIREMIA (sensitivity analysis) (N=182) – *omitted (don't know/refused/missing) (N=5)*

Characteristics	HCV-viremic rate Survey adjusted estimate % (95%CI)	Univariate cOR (95% CI)	p-value	Multivariate aOR (95% CI)	p-value
All participants	66.6 (58.7-73.7)				
Camp			0.892		0.702
12	60.2 (42.8-75.3)	1.0		1.0	
8W	66.3 (41.0-84.7)	1.3 (0.4-4.2)		2.1 (0.5-8.5)	
13	75.3 (55.0-88.4)	2.0 (0.7-6.1)		2.1 (0.7-6.6)	
16	65.4 (41.3-83.6)	1.3 (0.4-4.0)		1.3 (0.3-4.8)	
17	82.4 (17.5-99.0)	3.1 (0.3-30.0)		6.8 (1.1-40.5)	
18	67.6 (45,6-83.9)	1.4 (0.5-4.2)		1.3 (0.5-4.0)	
19	62.5 (39.7-80.9)	1.1 (0.4-3.3)		1.3 (0.4-4.4)	
Sex			0.240		0.230
Male	74.6 (58.5-85.9)	1.0		1.0	
Female	64.4 (55.1-72.7)	0.6 (0.3-1.4)		0.6 (0.2-1.5)	
Age (years)			0.288		0.180
18-24	77.8 (30.0-96.6)	3.1 (0.4-21.0)		2.7 (0.3-21.5)	
25-34	73.7 (60.7-83.6)	2.5 (0.9-6.7)		2.3 (0.7-7.7)	
35-44	57.9 (41.6-72.6)	1.2 (0.4-3.4)		1.2 (0.4-3.9)	
45-54	53.3 (32.7-72.9)	1.0		1.0	
≥ 55	71.7 (49.4-86.8)	1.1 (0.5-2.6)		3.2 (0.8-13.3)	
Having received treatment for HCV infection			**<0.001**		**<0.001**
Yes	22.8 (7.6-51.3)	1.0		1.0	
No	71.7 (63.4-78.7)	8.6 (2.5-29.4)		9.2 (2.1-39.8)	

Epicentre
14-34 av Jean Jaurès, 75019 Paris, France
Association loi 1901

+33(0)1 40 21 55 55

epimail@epicentre.msf.org
www.epicentre.msf.org